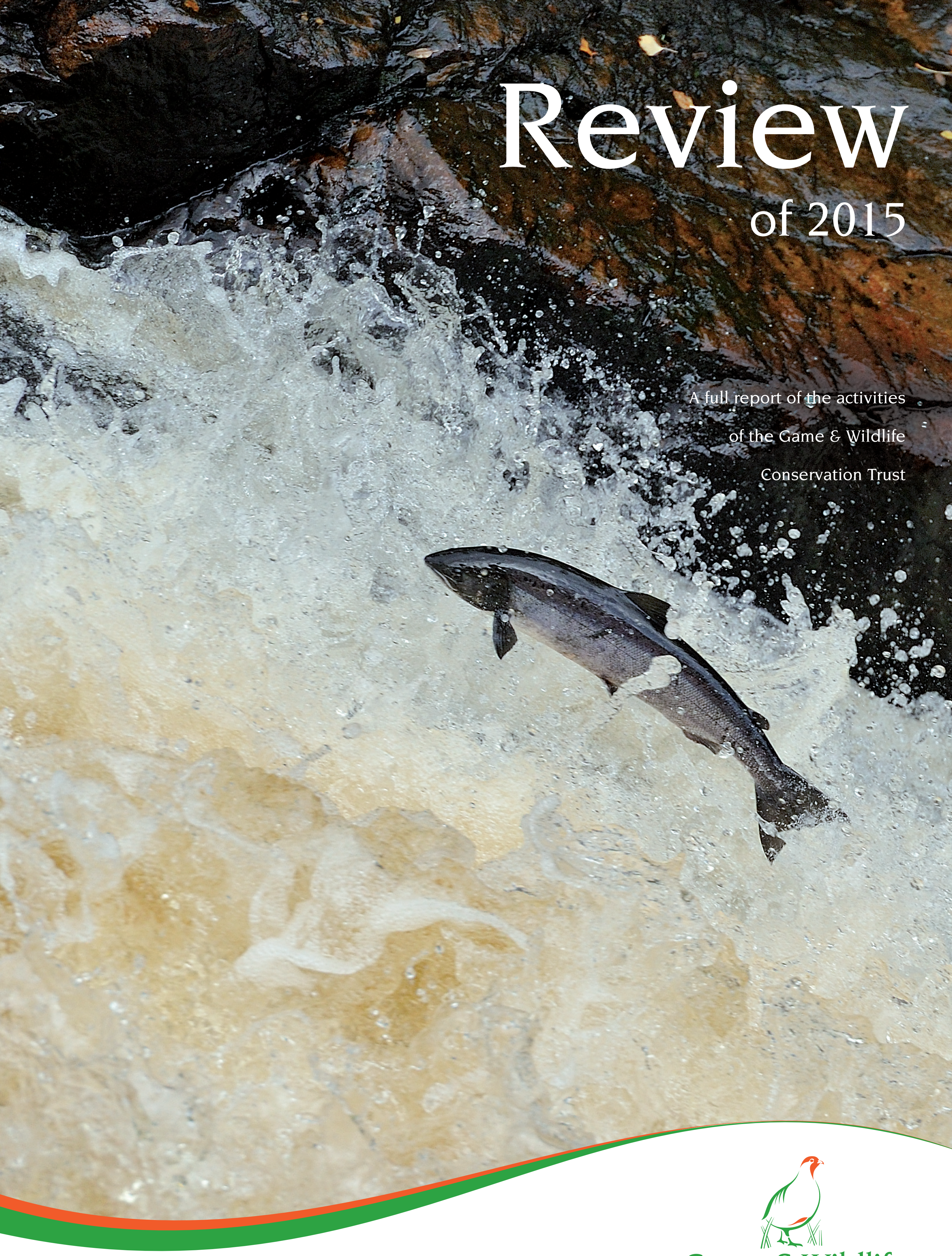

Review

of 2015

A full report of the activities of the Game & Wildlife Conservation Trust

www.gwct.org.uk

Game & Wildlife
CONSERVATION TRUST

Review of 2015

Issue 47

A full report of the activities of the Game & Wildlife Conservation Trust (Registered Charity No. 1112023) during the year

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GAME & WILDLIFE CONSERVATION TRUST OBJECTS

- To promote for the public benefit the conservation of game and its associated flora and fauna;
- To conduct research into game and wildlife management (including the use of game animals as a natural resource) and the effects of farming and other land management practices on the environment, and to publish the useful results of such research;
- To advance the education of the public and those managing the countryside in the effects of farming and management of land which is sympathetic to game and other wildlife.
- To conserve game and wildlife for the public benefit including: where it is for the protection of the environment, the conservation or promotion of biological diversity through the provision, conservation, restoration or enhancement of a natural habitat; or the maintenance or recovery of a species in its natural habitat on land or in water and in particular where the natural habitat is situated in the vicinity of a landfill site.

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Game & Wildlife CONSERVATION TRUST

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as of 1 January 2016

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South-west Wales	no chair
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Worcestershire	Mark Steele
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Highland	Chris Swift
Grampian	Ali Loder
Tayside	Mike Clarke
Fife & Kinross	Douglas Williams
South-east Scotland	Tim Wishart
West of Scotland	David MacRobert
Dinner Chairman	

Names in brackets were chairmen that stepped down during 2015

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Working together for conservation

by Ian Coghill, Chairman and Teresa Dent CBE, Chief Executive

© Hugh Nutt

(Top) Farmer Clusters, such as the Selborne Landscape Partnership, are now becoming part of national policy. © Peter Thompson/GWCT

For the *Review of 2014* we wrote an article highlighting the 30 years that have passed since the GWCT had its first meeting with a Government minister about the hen harrier-red grouse conflict. The readership of this publication must be smaller than many – though a select and wonderful group of people – so I doubt that article in itself made a difference, but clearly enough people had begun to think that the impasse had gone on long enough and did little to help the hen harrier: in January 2016, Environment Minister Rory Stewart published the Hen Harrier Joint Recovery Plan.

I am delighted to say that the plan has been welcomed by all sides. As well as continuing existing efforts to prevent wildlife crime, it states an intention to trial a brood management scheme for harriers, which is, in essence, the 'quota' scheme that my predecessor, Dr Dick Potts, first mooted many years ago. He made the point that the harrier's 'lifestyle' creates a problem; its semi-colonial nesting behaviour means that the number of nesting harriers on one moor can rapidly build to the point that the harrier impact on grouse numbers renders shooting unviable. Once shooting ceases, so does keepering, and with the return of predators, harrier nesting success will plummet (as shown at Langholm). If that local density problem can be addressed by removing harrier nests that go beyond a local threshold density and rearing the chicks elsewhere for re-release, grouse moors and harriers should be able to co-exist, and overall the population of nesting harriers should rise. There are also plans to re-introduce harriers to other upland areas, say in the south-west and also, maybe to lowland areas. Interestingly, hen harriers nest in lowland landscapes in continental Europe.

'What wildlife would you like to have on your farm?' is a question we in the GWCT have been asking groups of farmers who are interested in developing their own landscape-scale wildlife conservation projects – these farmer-led voluntary projects are known as Farmer Clusters. We were delighted last year when Natural England, which kindly funded the Farmer Cluster pilot, provided on-going funding for this idea by setting up a facilitation fund within agri-environment. This allows any groups of farmers who want to work together at landscape scale to employ an advisor to help them. Last year 19 Farmer Clusters were approved for funding, and we believe many more will apply in 2016. It is great to see an idea sparked by a conversation with a Natural England manager at our research conference in 2012, now becoming national policy.

This year's *Review* is the usual cornucopia of fascinating facts and projects, from our work on bees (page 46), to success with black grouse recovery (page 42) and how much corvid control can help the breeding success of hedgerow-nesting birds (page 14). We are concerned to find that our resident breeding population of woodcock declined by 29% between 2003 and 2013 (page 20). This rate of decline means that woodcock has gone onto the Red List of species of conservation concern. We believe it should remain a quarry species, in the same way that grey partridge remains on the quarry list, as those who shoot woodcock tend to have the most power and desire to improve woodcock conservation. The GWCT has, in recent years, undertaken one of the biggest single pieces of work researching woodcock ecology in Europe; all that work has been directly funded by our members and supporters, particularly those who have developed a passion for and interest in woodcock as a sporting bird. Nonetheless, it will be important to understand what drives changes in our local woodcock population, whether it comprises winter migrants or native breeding birds, and carefully manage shooting around that information so that your children can enjoy these amazing birds as much as you do. We are looking in detail at the causes of decline and hope to publish a paper on that shortly.

2015 has been another year where we have been humbled by, and are enormously grateful for, the support we get from our members, supporters, donors, voluntary fundraisers, sponsors and committed but unpaid trustees. Quite literally none of what is reported in this *Review* could have happened without that support. It is an enormous pleasure to travel up and down the country to events, game fairs and dinners, and have a chance to meet those supporters and thank them. Our staff continue to do a wonderful job, often with limited resources, and their commitment and expertise is fantastic.

Our work on bees and agri-environment schemes is covered on page 46. © Peter Thompson/GWCT

Demonstrating our messages effectively

by Alastair Leake, Director of Policy and Adam Smith, Director Scotland

The Cairngorms National Park Authority visit GWCT Auchnerran. (L-R) Allan Wright (shepherd manager, Auchnerran), Hamish Trench, Doug Stewart, Andrew Salvesen OBE (chairman GWCT Scotland), Dave Parish (head of GWCT lowland research) and Grant Moir. © Adam Smith/GWCT

Our ability to publish high-quality science in the field of conservation management has been a hallmark of the GWCT, but publishing our science alone is not sufficient to influence decision makers and policy officials. Our English demonstration farm, the Allerton Project, is proving increasingly valuable in getting our message across and we now host regular meetings with Defra officials there.

A particular focus of our work in 2015 has been the redesign of Countryside Stewardship. We have always been supportive of Sir Don Curry's 2002 report on the *Future of Farming & Food*, which advocated 'a broad and shallow' agri-environment scheme that rewarded farmers for their environmental work. The scheme was open to all, and in England over 70% of farmers embraced it. As time has progressed the scheme has evolved to become more focused on outcomes, and some options have been lost while new ones, such as supplementary feeding and field corner settlement ponds – both options championed by GWCT scientists – have been added. Reductions in budget mean that going forward the scheme will be more competitive, and this has led to renewed interest in our BASIS Conservation Management course, as people seek to increase their knowledge and with it their chances of getting a scheme proposal accepted. Negative publicity surrounding the proposed inspection regime for the new scheme is deterring farmers from re-entering, so we have invested a great deal of effort in making the scheme more user-friendly.

Linked to this is much of our other English policy work. Ensuring that the 'architecture' of any scheme is correct is important, but ensuring we have the correct tools in the box to enable farmers, landowners and gamekeepers to manage wildlife is equally important. This requires relentless effort. The EU is signatory to the Agreement on International Humane Trapping Standards (AIHTS), which was signed in 1997 and means that some types of trap will need to be withdrawn from use in 2016 (see page 64). The AIHTS establishes criteria for rating traps by species and by method of use. Killing traps are rated according to the time to loss of consciousness; restraining traps are rated according to injuries indicative of poor welfare. Ratings form part of the approval process. Yet traps are an essential part of the equipment we need to manage wildlife, so we have been instrumental in campaigning for new traps to be tested to meet the international standard. The autumn meeting of our All-Party Parliamentary Group (APPG) drew MPs' attention to the important role traps and snares play in wildlife management. Getting MPs to understand that snares are humane restraining devices that GWCT scientists have spent much effort in making more target-selective, rather than strangulation devices, is critical to ensuring they get a fair hearing.

This year has seen success in a range of policy issues: we pressed for cover crops and legumes to be included in Pillar 1 greening measures, and to ensure the sowing and destruction dates were sensible and enabled farmers to take these options up without them constraining production; we are working to get the three-crop rule changed to require a sustainable rotation to be followed; we have helped to ensure Asulam is still available for moor owners to control bracken on heather moorland; we have ensured that neonicotinoid seed dressings can still be used to protect kale from flea beetle attack; we have helped to put together a training course for keepers in the best practice of using second-generation anticoagulant rodenticides to ensure that these essential tools can still be used in the countryside, while minimising the risk of secondary poisoning of non-target species; we have helped to bring forward a consultation on the licensing requirements for great crested newts; we have actively promoted the Campaign for the Farmed Environment through our chairing of the Delivery Group, which is encouraging farmers to keep unproductive land for wildlife. Although each of these is a small step in its own right, collectively they have a substantial impact on the way we manage the countryside.

2015 was another important year for Scotland, as policy and land management practice struggled to find a balance around income, subsidy, regulation and conservation. GWCT Scotland was at the heart of the many debates, with the factual evidence of what we need from our countryside, and what farming, forestry and shooting can deliver.

We have been closely involved in the Land Reform discussion and its evolution, promoting the benefits of individual stewardship of the land for conservation. Our evidence on investment and incentive for conservation has been discussed in this context by Holyrood's Rural Affairs Committee, and we remain focused on ensuring sporting rates are applied with an awareness of good game management's contribution to Scotland's countryside.

Our other work on the steady round of public consultation has continued as well, covering lynx re-introduction, salmon licensing, and EU REFIT of the Birds and Habitats Directives. We have also had major roles in two external policy reviews. The Scottish Moorland Forum's Understanding Predation compared and contrasted the science-derived knowledge about predation impacts on species including grey partridge and curlew, with the local knowledge of farmers and keepers. The results of this will have an important role in shaping future Scottish Government approaches to predator control.

Scottish Natural Heritage (SNH) reviewed Sustainable Moorland Management after being challenged on a number of fronts, including mountain hare, peat and raptor conservation. Our on-going collaboration with SNH and the James Hutton Institute on mountain hare monitoring helped us ensure a rational discussion about the management of this species. The final review highlighted that defining either sustainable moorlands or how to sustain moorlands is not easy, with more work to be commissioned. Our external contribution to this contemporary debate was to produce, for the first time, a comprehensive package of policy statements on how the GWCT would wish to sustain Scotland's moorlands. *Sustaining Scotland's Moorland* was launched and profiled at a moorland event in Holyrood.

A pragmatic, evidence-led approach to conservation is vitally important in persuading policy makers – wrapped up in delivering a healthier, fairer, greener, wealthier Scotland – that game and wildlife are part of the mix. So innovation in game crops, important for pheasants and farmland songbirds, took root in a Fife-based project with the aim of promoting cheaper, simpler, more effective conservation crops to the Scottish Government's Rural Payments and Inspections Division.

We built on our work with the land managers who devote their time to protecting and enhancing our countryside. We started working with our first Scottish Farmer Cluster, on Deeside, to show how our farmers can lead the way in conservation of rare species at larger scales. Our monitoring and mapping encouraged the farmer group to identify bees, hares and lapwing as species they would like to see enhanced. Taking their ideas for how to do this to SNH and the Scottish Government and making them happen is the next stage. We need to pursue this approach.

Crucially in addressing such challenges, we began tenanting our own Scottish demonstration farm, GWCT Auchnerran. This will build on the success of the GWCT's Allerton Project but in the very different farming and sporting context of the 'hill-edge'. The farm is grass-dominated, home to 1,500 hill-hefted blackface sheep, and rich in game and some of our most significant wildlife, including brown hares, curlew and black grouse. 2015 was the first of a two-year baseline monitoring exercise, which we will report on after 2016.

Such demonstrations in the real world help conservation because some policy support is not always so easy to achieve. This is clear from what we are learning at Whitburgh Farm and Langholm Moor. Despite outstanding habitat management and legal predator control, wild gamebird populations are struggling against the combined effects of weather and increasingly hard to manage pressure from 'once rare, now common' predators. Yet despite visits from key policy makers and buy-in from Government agencies, even conducting trials to quantify these potential impacts cannot be moved forward easily. We hope the thinking around *Understanding Predation* will help address this blockage.

Auchnerran, our new Scottish Demonstration farm, is home to 1,500 sheep. © GWCT

In 2015 we helped redesign the Countryside Stewardship scheme. © GWCT

Ambassador for keeper-led conservation

by Roger Draycott,
Head of Advisory

Mike Swan receiving his NGO Educational Trust Bellamy Award for Conservation from Brian Hayes (NGO Educational Trust) and Joe Dimbleby, editor of Shooting Times. *© Olly Dean/GWCT*

A key aim of the Advisory team is to help land managers implement the practical conservation research of the GWCT to conserve and enhance the wildlife in the countryside. We do this in lots of different ways, from formal one-to-one visits where we advise on specific game and wildlife issues on a farm or estate, through to talks, farm walks and lectures for a myriad of interested parties. In 2015, advisors were able to help communicate the work of the GWCT at over 200 events throughout Britain on broad-ranging subjects including our latest research on breeding woodcock ecology and migration patterns, safe use of rodenticides, cover crops, Countryside Stewardship, sustainable released game shooting, grey partridge conservation, soil and water conservation and best practice predation control.

In 2015 we made good progress with our Shoot Biodiversity Assessment service. So far we have worked with over 30 large pheasant shoots to help them demonstrate that their shoot management is benefiting biodiversity conservation. This is important because some conservationists are sceptical of the environmental credentials of large-scale pheasant releases. Our research forms the science base for this service, which helps provide an informed opinion and practical advice for pheasant shoots. The assessment allows buyers of game shooting to be confident that shoots are following the Code of Good Shooting Practice and best practice game management guidelines, as well as reassurance for consumers and retailers of game meat that game is sourced from sustainably managed shoots. I urge all shoot managers to consider supporting the GWCT in this initiative.

As a charitable organisation, education is one of our key objectives. We spoke to students at most of the universities in the UK that run wildlife management and conservation MSc courses. These young people are the next generation of conservation officers, land agents, policy makers and farm business managers. We also speak at many vocational training colleges. This is vital as it enables us to engage with the next generation of gamekeepers who will be responsible for looking after hundreds of thousands of acres of rural Britain in the future. We have good contacts at most of the colleges that run gamekeeping courses and we are looking to expand this further in 2016.

We were delighted that Mike Swan, our advisor and head of education, was awarded the National Gamekeepers' Organisation (NGO) Educational Trust Bellamy Award for conservation in 2015. This award was launched in 2010 to recognise those who display exceptional creativity and initiative in promoting the gamekeeper's role in sustainable countryside management. On presenting the award Brian Hayes, the NGO Educational Trust Administrator, said: "You couldn't have a better winner of this award than Mike Swan. I am so pleased he has won it. No one in the countryside makes the case better than Mike for the vital role game and gamekeeping play in sustainable countryside management. He is a practical, hugely knowledgeable countryman with brilliant communication skills. I know for a fact that Mike has won legions of folk around to our way of thinking over the years. He's like a one-man PR machine promoting keeper-led conservation. A big well done."

In 2015 Austin Weldon completed his training period and is now based at the Allerton Project at Loddington in Leicestershire. He is the first point of contact for all advisory business and educational activity in central England and is also responsible for the day-to-day running of our demonstration shoot at Loddington.

We are delighted that the GWCT's approach to farmland conservation by working alongside farmers at the landscape level through the Farmer Cluster initiative is starting to gain national appeal. This concept is now embedded in the Countryside Stewardship scheme. In 2015, 19 landscape-scale projects were funded through Natural England's facilitation fund and more are planned for 2016. The Advisory team continue to play an important role, both acting as facilitators for some clusters and providing advice and training to clusters facilitated by other individuals and organisations. On a recent visit to a farm in the Selbourne Landscape Partnership, the Secretary of State for Food, Environment and Rural Affairs Elizabeth Truss, saw first-hand how 11 farmers covering 10,000 acres of land are working together to conserve harvest mice, barn owls, wildflowers and several butterfly species alongside conventional farm businesses. The Secretary commented that landscape-scale farmland conservation should become "business as usual".

ACKNOWLEDGEMENTS

We are grateful for financial support for our tertiary education programme from The Eranda Foundation, Chartley Foundation, Payne-Gallway Charitable Trust and the Dorus Trust.

On a recent visit to a farm in the Selbourne Landscape Partnership, the Secretary of State for Food, Environment and Rural Affairs Elizabeth Truss, saw first-hand how 11 farmers covering 10,000 acres of land are working together. © GWCT

An exciting medley of events

by Edward Hay,
Director of Fundraising

The North Yorkshire clay shoot raised £80,000 split between the Trust and the Army Benevolent Fund. © Josh Harrison

2015 was an outstanding year for the Fundraising team. Not only did the number of fundraising events increase, but their diversity throughout the country was substantial. Ferret racing, hip flask challenges and tours of gun-making factories and breweries, to name but a few, are attracting new and young people to the Trust. Indeed, more than 200 new members joined having attended our events. Our county calendar fixtures continues to grow, attracting sponsorship from local and national companies.

The US committee raised a staggering £220,000 from its annual New York auction. This is only made possible by the generous donations both here and in the US. London continued to build on last year and the 10th Le Gavroche dinner, kindly hosted by Michel Roux Jr, raised a record £95,000. The 36th London Ball at the Dorchester was an enormous success, raising an incredible £165,000 as the London Ball committee, headed by Chairman Lord Guernsey, hosted a vibrant, fun-packed evening.

A number of exciting clay days were run across the country. The Hertfordshire committee held its clay day at Hatfield House, by kind permission of Lord and Lady Salisbury, raising £43,000, while the North Yorkshire committee ran a clay day with the Army Benevolent Fund, raising £80,000 with proceeds split between the two charities.

An evening advisory walk was held in almost every county. These walks provide an opportunity to showcase how management for game benefits our countryside, and are an invaluable way to demonstrate the work that the GWCT is doing. A warm thank you to all the owners whose estates and farms hosted such events.

I must also thank all those who contribute to our sweepstake initiative. £133,000 was raised in 2015 generously donated by individuals and syndicates across the country. Below is a small but varied sample of the many events run last year:

- Buckinghamshire's popular ferret racing evening raised over £6,000. Derbyshire ran a sell out four grouse moor raffle, raising £50,000. The winner then very generously re-offered the day, which was auctioned at the London Ball.
- Essex raised over £25,000 from its clay day and the 33rd annual shooting and auction evening in Sussex raised £19,000. Hampshire held a fun 'call my bluff' wine tasting and auction, raising £18,000.
- Gloucestershire launched a High Four raffle, while Herefordshire raised £16,000 at an auction and dinner. Nottinghamshire held a game cookery evening and brain cells were tested at a Lincolnshire quiz.
- The Somerset Draw for Four raised £19,000, Sir Max Hastings was guest speaker at the Wiltshire dinner raising £20,000, while North Wales held a cookery demonstration, raising £3,000. The Underley Team Challenge held by the Lancashire and Cumbria committees, saw teams competing in clay shooting, fishing, dog scurrying and digger driving. Reviving an event last held in 1999 this raised £6,000.

None of these events would be possible without the dedication and commitment from our county chairmen and their spirited committees. I also would like to thank the continued and wonderful generosity of members, donors and sponsors. Fundraising generates the biggest income stream to the Trust and is one of the best ways to communicate our message and research to the wider public.

Above all, our events are fun and enjoyable, so I am looking forward to an exciting year in 2016 – my final before retiring from the Trust – where we continue to build on our achievements and successes. Thank you for your on-going support.

The 36th London Ball raised an incredible £165,000. © The Field

Going back in time

by Nick Sotherton
Director of Research

The *Review* reports and showcases some of the research work that has been conducted by our scientific teams over the past year. As usual, there is a mixture of reports on work reaching completion and some of the messages coming from our long-term databases. Collecting data every year, be it on numbers of red grouse, insects in Sussex wheat fields or bag records for woodcock, may seem of small value compared with spending money on some of the big issues currently facing game management, but the information contained in these long strings of data is unique and invaluable. Many of our long-term databases are of little use until they are more than 15 years old, but all of them are now over 40 years old, with our National Gamebag Census (NGC) going back to the 1850s for some species. Remember, Charles Darwin only published *On the Origin of Species* in 1859! In this *Review* we provide annual updates of these databases, but for the NGC Nicholas Aebischer has reviewed the information on woodcock, magpie, carrion crow and grey squirrel (see page 30).

These analyses go back to 1961 and clearly show the increases in the predatory species that, to some, are a cause for concern. Using these data in the long term, we can continue to monitor any increases in corvid numbers, or decreases if culling strategies are ever established at a national level. The woodcock data will give us an insight into the reasons behind the declines in woodcock range and abundance that we report on page 20. Remember, no one else holds this information, and therefore we can join the conservation debate regarding these species with quality scientific evidence.

More and more of our research is now facilitated by technology, especially the improvements in our ability to track animals. We have seen the work by Andrew Hoodless and his team on woodcock and how some of these birds wintering with us then go on to make long journeys eastwards, back to their breeding grounds in Scandinavia and Russia. We are approaching the 60th woodcock fitted with a satellite tag. We are also beginning to see how sea trout smolts navigate their way out of the river where they were born and out to sea (see page 74). In future, we may again mount an appeal to buy tags for other species. As always, the generosity and support of our members will help take us forward.

Finally, our research team published 40 papers in 2015, including the publication and successful defence of seven PhD studies with students from universities such as Exeter, Imperial College London, Newcastle, Reading, Lund in Sweden and Vancouver in Canada. Our warmest congratulations go to them all. Seven successful defences in a single year is a 35-year record. Our first PhD thesis was defended in 1980 by someone called Nick Sotherton. Whatever became of him?

We are looking at how sea trout smolts navigate their way out to sea. © *Bill Beaumont/GWCT*

We have now fitted nearly 60 woodcock with satellite tags. © *GWCT*

Physician heal thyself

Mike Swan describes some of the ways in which GWCT research has been translated into practical management on his own shoot

We site brood strips alongside beetle banks where we expect our birds to nest. © Mike Swan/ GWCT

North-east Dorset may not be the place where you would traditionally expect to find a wild pheasant shoot, but this particular GWCT game advisor tries to run one there, in partnership with his friend, the NGO's political consultant Charles Nodder. This little shoot, which Charles and I have been playing at since 1997, is a very low-key affair, and we simply aim to produce enough game to go for an armed nature ramble with a few chums five or six times each season, and then send everyone home with a brace or two for supper.

Both being professionally involved in game management, we concluded right at the start that we did not wish to spend our spare time looking after pens of birds, so apart from a few redlegs released in the first two seasons, this is a genuine attempt at producing wild-bred birds. Pheasants are the bread and butter game species, but we also have a few cherished wild grey partridges, which we actively try to conserve.

Three-legged stool

Way back in the early 1980s, when I first came to the GWCT, the then director of research Dr Dick Potts taught me about a very important basic concept in conservation, and he called it the three-legged stool. What this says is that any species needs three basic things to thrive: a suitable habitat, sufficient food throughout its life, and freedom from excessive predation. Also, just as the legs of the stool must be roughly equal in length to avoid collapse, so these three basic needs must be present in equal proportion. That concept has always remained in mind as we have moved forward with the shoot. So with the basic habitat of woods, hedges and cover crops in place, we provide the following things to try to make up the key food and predation legs.

Spring feeding

The normal doctrine when I began at the Trust was that February and March were hungry months, and that you should feed your pheasants until about Easter. Gradually we began to realise that this is no longer enough. The change to winter cropping with fewer stubbles left over winter, improved harvesting efficiency, and better weed control mean that there is far less 'free' pheasant and partridge food in late winter.

Comparison of sites where food was provided into May with those unfed, showed that the average hen pheasant fledged almost twice as many young when she had access to more food, so one of our first actions when we took over in February 1997 was to put out some simple hoppers and fill them with wheat. About 60 of these are now deployed along wood edges, hedgerows and beetle banks, where the pheasants and partridges set up their breeding territories.

(Clockwise from top) We have the habitat in place for our wild pheasants to breed; Spring feeding - a metal drum hopper at the centre of a favourite pheasant territory; a Larsen trap with a crow decoy - all researched and developed by the GWCT. © Peter Thompson/Mike Swan/GWCT

Brood cover and chick food

In my earliest days at the GWCT, my scientific colleagues hit upon the concept of the conservation headland. This was a strip at the edge of a cereal field, sown to the crop in the normal way, but kept free from the usual herbicide and insecticide sprays. The result was something akin to a corn crop of a century ago, with poppies and other broadleaved weeds, and lots of little creepy crawlies to feed the pheasant and partridge chicks.

The modern version is a deliberately sown strip of cereals, with no inputs, and we have about four kilometres of these across the shoot. They are only about three metres wide, and are mostly sited alongside beetle banks or hedges, where we expect our birds to nest.

Brood strip in spring. In a few weeks it will be an important insect source for foraging chicks. © Mike Swan/GWCT

Controlling predation

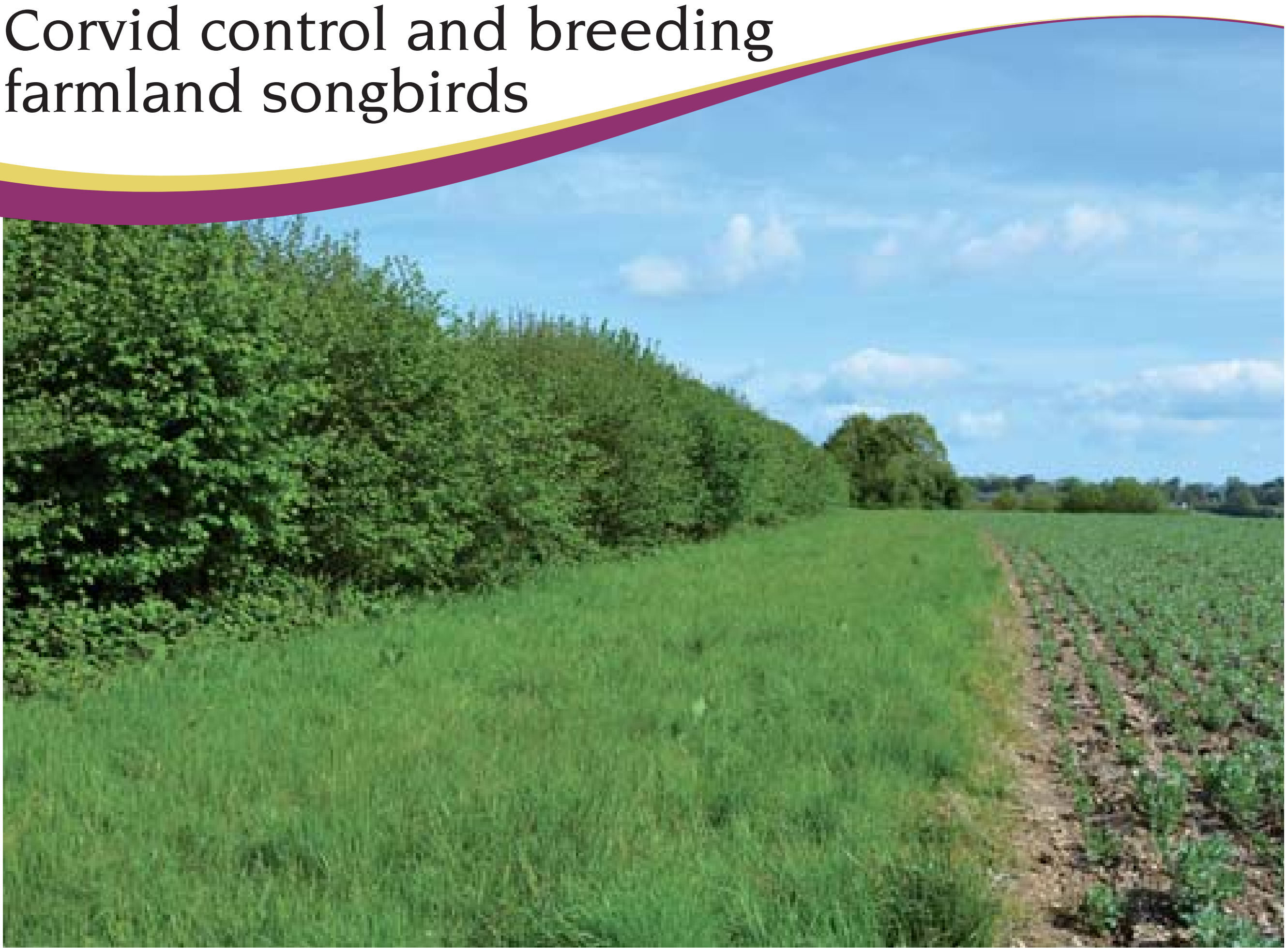
Achieving even a modest harvest of wild pheasants relies on controlling predation to some degree, and the Trust's research into this has been fundamental in defending and promoting the need for predator control. For a pair of amateurs like Charles and myself, time constraints make it impossible to do what a full-time professional would, but we can set about some key aspects in an efficient and professional manner.

The GWCT's pioneering work in developing the fox snare as a humane and target-specific tool has meant that we can mount a spring and early summer control programme that really works for us. This takes the pressure off our breeding hens, and means that far fewer are killed on the nest.

Our other key predators are crows and magpies, and here Larsen traps have been revolutionary. In this respect it is as well to remember that this technique was pretty much unknown in the UK until the Trust rediscovered it 25 years ago. Although we cannot take the credit for inventing the trap away from Mr Larsen, the Danish gamekeeper, it was GWCT research that taught us how to use it, and proved its worth as perhaps the most target-specific method of predation control that we have. We run up to six Larsens from March to the end of June.

There is, of course, much more too, and lots of other details such as rat control, woodland management and hedgerow trimming have to be attended to, but I really do think it is fair to say that we could not run this little shoot if we did not have the benefit of the GWCT's research to inform us.

Corvid control and breeding farmland songbirds



Magpies and crows are known to be capable of suppressing the breeding output of ground-nesting birds but what about birds nesting in the cover of hedges? © GWCT

KEY FINDINGS

- We undertook a four-year field experiment at 16 different sites.
- Corvid control reduced crow and magpie numbers but did not eliminate them at any site.
- Hedgerow songbirds produced fledged broods in the presence of crows and magpies at all of our study plots.
- Overall songbird breeding output increased by on average 11% with corvid control.

Rufus Sage

Assessing the potential for predator reduction to have a biologically significant impact on prey species is important for practical and ethical reasons. At the moment, conservation of farmland birds is sometimes cited as a reason to undertake crow and magpie control in the spring. Currently the evidence on the impacts of corvid removal is mixed – in short, crows and magpies are accepted by the RSPB and others as potentially important nest predators of ground-nesting birds, but not of birds nesting off the ground. To provide further information we undertook a four-year, 16-site experimental

We looked at songbirds that nested in hedgerows, such as yellowhammers. © Keith Cowieson/SBS study with randomised treatments and paired controls, which focused on hedgerow-nesting songbirds. The study was funded by SongBird Survival (SBS) and facilitated by the voluntary participation of 16 sites across southern England.

Each lowland farmland site consisted of a pair of plots about 200 to 300 hectares each. Crows and magpies were controlled using best-practice techniques (mainly Larsen trapping) under Natural England licence in one randomly selected treatment plot containing at least four kilometres of hedgerow. No corvids were removed from the other pair plot. We measured productivity of hedgerow-nesting songbirds in each plot using assessments of adult numbers and fledged brood counts without finding nests (similar to game counts). The method was tested in a SBS-funded pilot study and found to be effective for common species. Fledged brood-to-territory ratios were calculated for each plot for all songbirds and comparisons made between the removal plot and those where the corvids were not removed.

Corvid control operators caught crows and magpies in every removal plot but at no sites were crows or magpies completely removed. In the comparison plot (with no control) we counted on average between four and 13 crows or magpies per visit suggesting good corvid breeding densities at most sites. At 14 of the 16 sites, corvids were less common in the treatment plot, although we could not consistently separate breeding birds (which we think are more predatory) from non-breeders. Other predators were not disproportionately more common in one plot type than the other.

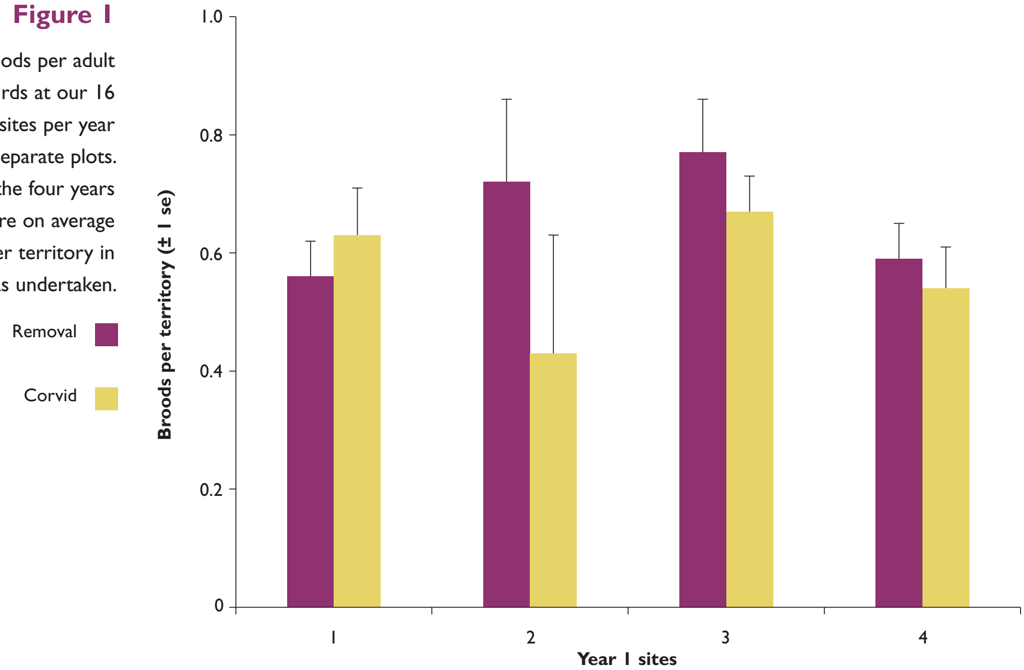
Twelve songbird species were seen in at least one or other plot at every site: blue tit, blackbird, blackcap, chaffinch, chiffchaff, dunnock, greenfinch, great tit, linnet, robin, whitethroat and wren. Bullfinch, goldfinch, song thrush, long tailed tit, yellowhammer and lesser whitethroat were seen at most sites and breeding by these 18 species dominated our analysis of corvid predation.

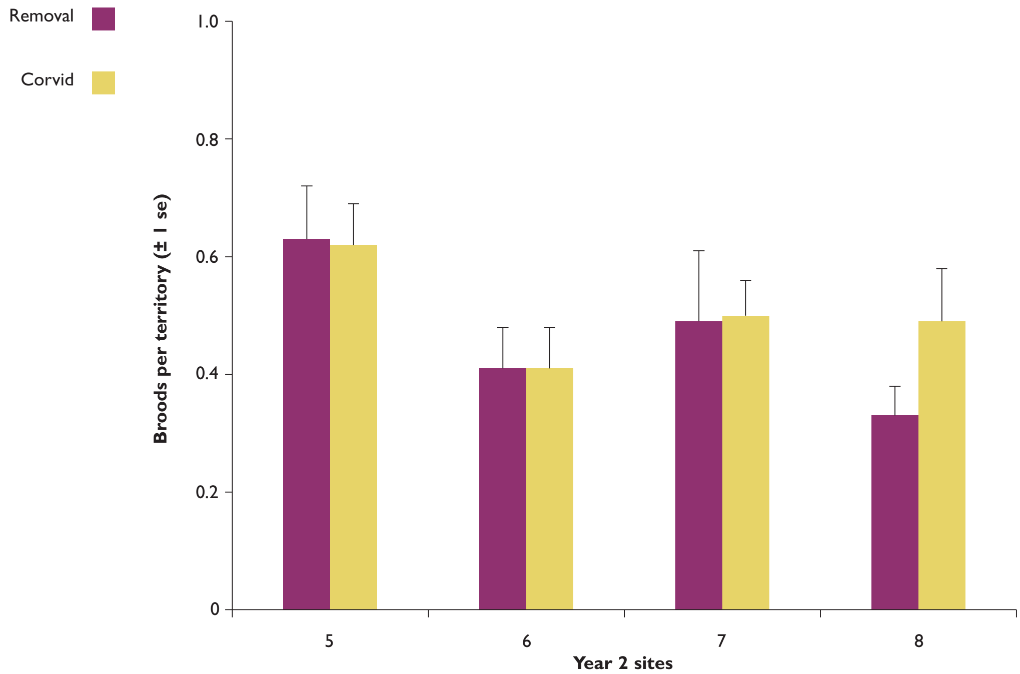
At 10 of the 16 sites in our study, overall songbird productivity was, to some extent, better in plots with corvid control (see Figure 1). In the remaining six it was either not different or higher in the plot without corvid control. There was no overall effect of treatment on the songbird brood to territory ratios ($F_{1,15}$=2.47, P=0.14). However, average productivity differed significantly between years ($F_{1,15}$=5.36, P=0.01) with

Magpies are adept at hopping about in hegderows like this. © GWCT

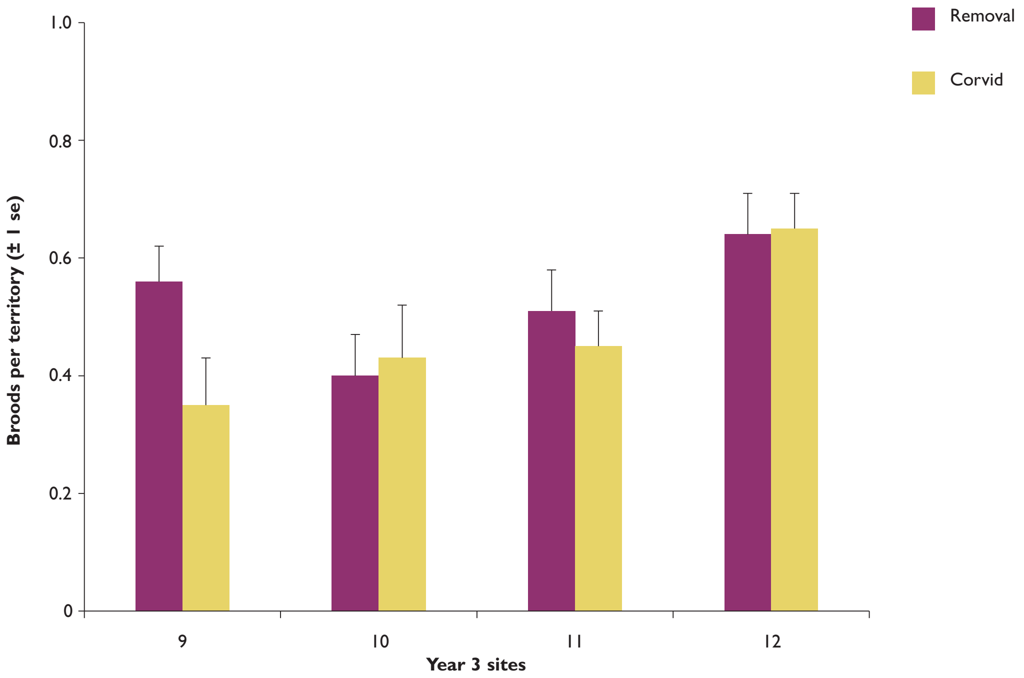
Figure 1

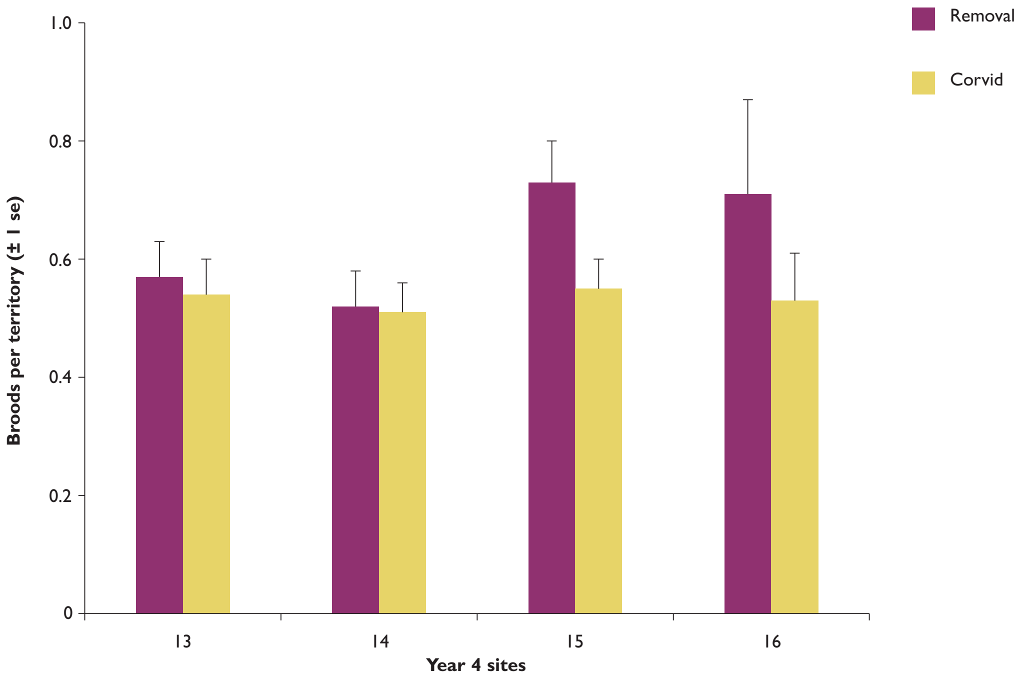
The productivity (fledged broods per adult territory) of hedgerow-nesting birds at our 16 study sites. We worked at four sites per year (2011-2014) as indicated by the separate plots. Using data from three out of the four years (not year 2, see text), there were on average 11% more songbird broods per territory in plots in which corvid control was undertaken.





The GWCT provides training courses and guidance notes on best practice in many aspects of predation control, including the use of Larsen traps.
© Keith Cowieson/SBS





overall productivity supressed in year two (2012). The 2012 breeding season was very unusual being especially cold and wet, so nationally songbird breeding output was exceptionally low (according to the BTO Nest Record Scheme). When we re-run the analysis excluding data from 2012, productivity was significantly affected by treatment ($F_{1,11}$=5.37, P=0.041).

In the three other years, songbird breeding productivity improved by controlling crows and magpies. The mean productivity estimate in the corvid plot type was 0.54±0.04 (mean±standard error). The mean difference between plot types was 0.06±0.03, so corvid control improved productivity by on average 11%.

The corvid removal did not eliminate crows and magpies from any study plots so complete removal may lead to a slightly larger effect. However, at none of our sites did uncontrolled crows and magpies eradicate hedgerow songbird nests. Our findings support the idea that best-practice corvid control can lead to a measurable overall improvement in the breeding output of farmland hedgerow birds.

ACKNOWLEDGEMENTS

We are grateful to SongBird Survival for providing financial support for this study. We also appreciate the support from 16 estates, farms and their staff.

Hatching success of lapwings in miscanthus

A lapwing nest in miscanthus. (Inset) A lapwing chick a few days old. © Henrietta Pringle/GWCT

BACKGROUND

Reaching the UK target of a 15% share of renewable energies by 2020 requires a significant contribution from domestic biomass supplies. One of the main biomass crops is miscanthus *(miscanthus x giganteus)*, also called elephant grass, 8,000 hectares of which has been planted in England since 2000. The Government's Biomass Strategy of 2007 suggested that by 2020, up to 1.1 million hectares could be under biomass cultivation. Because miscanthus is quite different from traditional arable crops in terms of its structure and management, such a change in land use could have implications for already-vulnerable farmland birds.

The low management intensity, lack of soil disturbance and reduced chemical inputs lead to more invertebrates and higher abundance and diversity of bird species in miscanthus than in other arable crops. However, miscanthus grows rapidly after harvest in early spring, forming thick swards that may be unsuitable as nesting habitat for ground-nesting birds. We investigated this by measuring the hatching success of lapwings nesting in miscanthus in Lincolnshire, Nottinghamshire and Yorkshire.

We found a total of 86 nests (between 2011 and 2013) in miscanthus and arable fields (barley, wheat and sugar beet) located on the same farms as the miscanthus fields wherever possible (see Table 1). Hatching success was lower in miscanthus (40.7%) than arable fields (57.8%) and higher in 2013 (73.6%) than previous years (44.5% and 34.7% for 2011 and 2012 respectively). The biggest difference in hatching success between crop types was found in 2012, when nests in miscanthus fields fared

TABLE 1

Distribution of lapwing nests between control fields* (n=32), and miscanthus fields (n=18) in 2011-2013

Year	Crop	Nests (successful)
2011	Miscanthus	4 (3)
	Control	9 (5)
	Total	13 (8)
2012	Miscanthus	18 (7)
	Control	22 (17)
	Total	40 (24)
2013	Miscanthus	21 (17)
	Control	12 (10)
	Total	33 (27)

** Control fields were barley, wheat and sugar beet. Miscanthus was harvested between the November and March preceding surveying.*

ACKNOWLEDGEMENTS

We are grateful to Biotechnology and Biological Sciences Research Council (BBSRC) for providing funding. Thank you to Andy Lee (International Energy Crops) for contacting miscanthus growers, and to all the farmers who allowed access to their land.

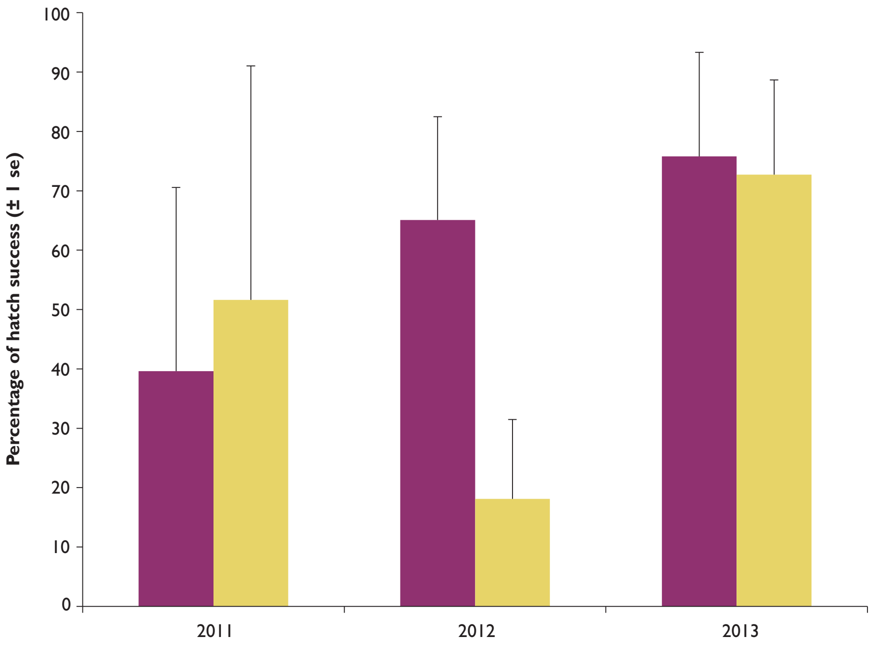


Figure 1

Hatching success of lapwing nests (n=86) in arable (n=43) and miscanthus (n=43) fields, 2011-2013

Arable

Miscanthus

particularly badly. In that extremely wet year, only 18.1% of nests hatched at least one egg, which was significantly lower than the 72.7% hatch rate achieved the following year. In contrast, the hatching success of nests in arable crops did not differ between years (see Figure 1).

Why should nest loss be higher in miscanthus? It could be that the height and structure of the crop makes it harder for lapwings to detect predators from a long way off, which is their main weapon in successful nest defence. Alternatively, there may be more predators in miscanthus, owing to greater food availability caused by the lower chemical inputs and greater cover than in arable crops. The increased vulnerability of lapwing nests in miscanthus fields, even if only in some years, has important implications for the expansion of biomass crop industry. If the area of land under miscanthus production increases, the reduced hatching success reported here may ultimately result in changes at the population level, although this link is yet to be tested.

Other work by the GWCT and RSPB has shown that miscanthus can be good for some farmland birds. However, established commercial miscanthus plantations are likely to be less patchy and weedy, possibly negating any benefits currently afforded by the crop. To ensure that increased miscanthus production does not come at the expense of lapwing and possibly other ground-nesting birds, the expansion must be achieved sensitively. Particular attention should be paid to the position of plantations within the landscape (ie. breaking up rather than creating monocultures).

KEY FINDINGS

- Lapwings nesting in miscanthus fields achieved lower hatching success (40.7%) than those nesting in arable fields (57.8%).
- 81.4% of nest losses were the result of predation.
- As biomass production expands to reach UK renewable energy targets, plantations of miscanthus need to be designed sensitively to avoid negatively affecting breeding lapwing and possibly other ground-nesting birds.

Henrietta Pringle
Rufus Sage

There is increased vulnerability of lapwing nests from predators in miscanthus fields.
© Henrietta Pringle/GWCT

The status of breeding woodcock in Britain

© Andrew Hoodless

BACKGROUND

In Britain and Ireland, the woodcock occurs as both a resident breeding species and a migratory winter visitor. To survey our British breeding population accurately, we co-ordinated the nationwide Breeding Woodcock Survey in collaboration with the British Trust for Ornithology (BTO). In both 2003 and 2013, observers made counts of displaying males at randomly-selected woodland sites across Britain, allowing us to produce estimates of population size.

KEY FINDINGS

- Between 2003 and 2013, the percentage of wooded 100 hectare squares occupied by woodcock dropped from 35% to 22%.
- Britain's breeding woodcock population estimate dropped from 78,346 males in 2003 to 55,241 in 2013, representing a decline of 29%.
- The rate of decline varied depending upon both geographic region and woodland area. Generally, the south and west of Britain showed the largest declines.
- Continued analyses of the Breeding Woodcock Survey data should reveal potential causes of decline.
- A new study aims to track woodcock to assess habitat use and breeding behaviour.

Chris Heward
Andrew Hoodless

In addition to the large number of overwintering migrants that arrive here each autumn, the British Isles are home to a small resident population of breeding woodcock. Together with the British Trust for Ornithology (BTO), we co-ordinated a nationwide Breeding Woodcock Survey that focused on this resident population. At dawn and dusk in spring, male woodcock perform their distinctive roding displays to locate a mate and this provides a means of counting woodcock during the breeding season when migrant visitors are absent. Volunteers made counts of roding males at dusk at over 800 randomly-selected woodland sites across the country, the results of which were used to produce regional and national estimates of population size.

The survey was first conducted in 2003 and the British breeding population was estimated to be 78,346 males. A repeat survey in 2013 produced a final estimate of 55,241 males, representing a decline of 29% in 10 years. This is supported by annual counts conducted at a sub-sample of 69 sites which showed a significant downward trend and an average annual decline of 4.9%. Widespread declines are also apparent in the BTO Bird Atlases, which indicate that site occupancy has fallen by 56% nationally at the 10km-square level between 1970 and 2010.

These datasets reveal broad geographic variation in woodcock distribution and decline. For instance, we found that 43% of Britain's total woodcock population reside in northern Scotland and our regional estimates in England also showed a strong northern bias. Some southern strongholds remain, such as parts of Hampshire and west Sussex, but in Wales, the southern Midlands and south-west England less than 10% of woodland sites were occupied. This uneven distribution is reported in historic accounts of the British range but, as far as the twentieth century is concerned, has been greatly exaggerated by recent declines.

Woodcock appear to be declining at a slower rate in regions where very large unbroken tracts of woodland occur. This probably provides an explanation for the regional trends we observed, including anomalies such as the comparatively large populations that remain in the New Forest and Thetford Forest. This relationship appears more complex than it may at first seem, however, and does not adequately explain all of the recent changes in woodcock distribution. Large areas of Wales and south-west Scotland have experienced notable declines (-48% and -59% respectively) despite being well-wooded. The geographic variation in the rate of decline suggests a relationship with woodland that is not just dependent on its size, but also the type and quality of woodland habitats offered. In the case of Wales and south-west Scotland, the maturation of conifer forests planted in the 1960s and 1970s is likely to mean that the majority of forests currently represent poor habitat for woodcock.

We do not understand what is driving the decline in our breeding woodcock, but we expect there to be multiple factors involved and regional differences in the principal cause. Changes in the suitability and management of woodland, changing climate, predation, deer, recreational disturbance and shooting are possible factors that we are investigating. For our latest advice on woodcock shooting, visit **www.gwct.org.uk/game/research/species/woodcock**

TABLE 1

Decline in regional population estimates (%) between 2003 and 2013

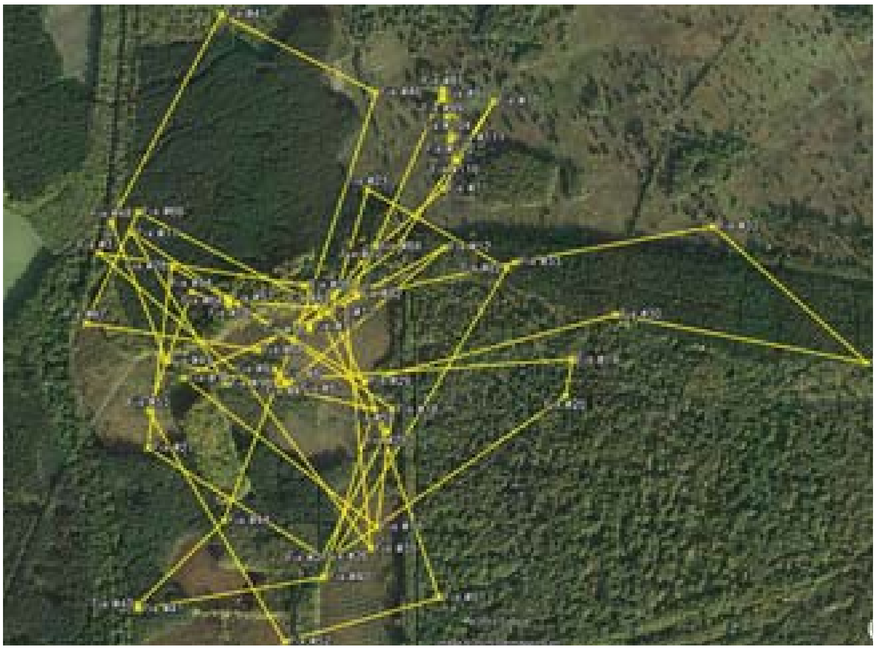
Region	Proportion of 100-hectare survey square occupied by woodland				Total
	10-30%	31-50%	51-70%	71-100%	
North Scotland	14.9	-47.9	-14.4	35.8	-0.7
South Scotland	-85.1	-51.0	-31.6	14.8	-59.2
Northern England	-33.1	31.6	-37.0	34.8	-18.9
North Midlands	-30.8	-36.7	32.7	39.9	-25.9
Eastern England	40.1	-10.5	-27.6	-43.5	-33.0
East Anglia	-72.1	-11.6	-20.0	-34.0	-48.6
South Midlands	22.8	-23.6	-55.9	-4.9	-20.7
Wales	*	60.3	-39.0	76.3	-48.2
South-West England	-45.5	-94.0	-8.3	-17.7	-57.9
Central South	-32.0	-66.3	-43.5	-17.0	-40.3
South-East England	-55.2	-12.5	-47.7	-50.8	-47.5
England	-43.0	-27.9	-29.9	-12.4	-35.0
Scotland	-19.5	-49.4	-21.1	29.8	-23.3
Wales	*	60.3	-39.0	76.3	-48.2
Britain	**-32.0**	**-39.6**	**-25.3**	**10.8**	**-29.4**

** Too few surveys were conducted within the smallest wood-size class in Wales to provide an estimate of trend.*

ACKNOWLEDGEMENTS

We are grateful to Greg Conway, Iain Downie and Rob Fuller of the BTO for their involvement in the Breeding Woodcock Survey and Simon Gillings for providing access to Bird Atlas data. Thank you to all the volunteers who participated in the survey, the BTO regional organisers, the surveyors who conducted annual counts between 2003 and 2013 and those who conducted supplementary counts in Scotland in 2014. Thank you also to the Birklands Ringing Group for their assistance in the field and the Forestry Commission and private landowners for access to their land.

While this is on-going, we are beginning a new phase of our woodcock research. In spring 2015, we started tagging woodcock with GPS loggers. These minute tracking devices allow us to record the behaviour and habitat preferences of woodcock during the breeding season, an aspect of the woodcock's ecology that we currently know little about. Tracking males during the breeding season is also providing a new insight into the woodcock's courtship display, information which is vital given that counts of roding males underpin our population and trend estimates.



The movements of one breeding male woodcock in a single evening. © Google Earth

Regulation of woodcock energy reserves in winter

Comparison of the abdominal fat pad in birds with low (left) and high (right) fat levels.
© Carlos Sánchez-García/GWCT

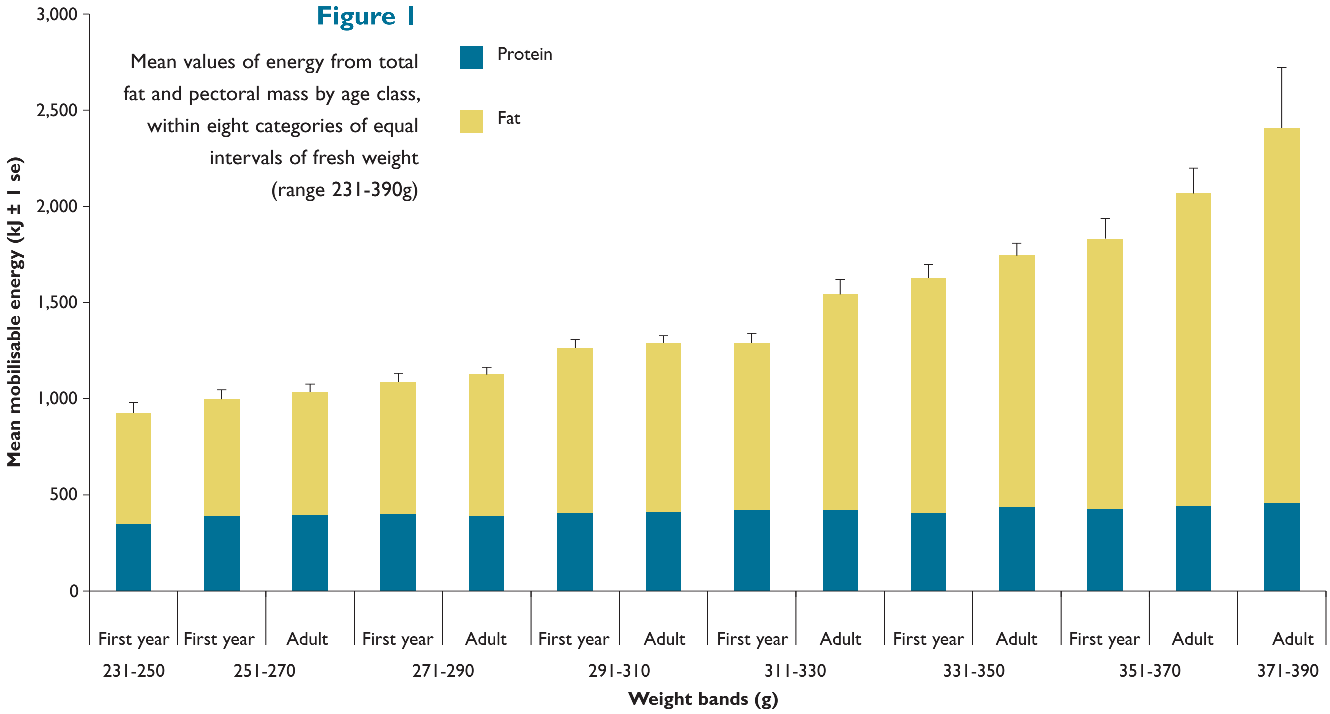
BACKGROUND

Winter can be a critical period for woodcock if freezing conditions prevent feeding. We studied the body condition and energy reserves of woodcock from different regions of Britain, aiming to assess their fasting endurance and their potential flight range if they decide to move to milder areas.

Our pioneering research on woodcock ecology in Britain has yielded important information on habitat use and foraging behaviour, the origin of migrants wintering in the UK, and the status of our resident breeding population (see *Reviews of 2013 and 2014*). This allows us to improve management decisions and alleviate any effects of changes in habitat, climate and hunting pressure. Winter is a critical period for woodcock, as they face a daily trade-off: carry too little fat and they risk starving in cold weather; carry too much fat and they reduce the speed of their escape response to predators (including hunters). We have studied the winter body condition and energy reserves of woodcock from different regions of Britain, aiming to assess their fasting endurance (the number of days they can survive without feeding during severe weather) and their potential flight range if they decide to move to milder areas.

Figure 1

Mean values of energy from total fat and pectoral mass by age class, within eight categories of equal intervals of fresh weight (range 231-390g)



We dissected a total of 221 woodcock collected on shoots between early December and late January during the winters of 2013/14 (n = 77) and 2014/15 (n = 144). Birds were from Cornwall, Lincolnshire, Wessex (Dorset, Hampshire and Wiltshire), East Anglia (Norfolk and Suffolk) and Scotland. We plucked and weighed the carcass, the major and minor pectoral muscles, the abdominal fat (see facing page), and we also dissected and weighed fat deposits in other locations (ie. pectoral muscle, neck, legs, back and guts). We were able to calculate energy reserves from the caloric densities of fat and muscle. Potential fasting endurance and flight range were then calculated from established relationships for waders.

The contribution of fat to the energy reserves was higher than that of protein for all birds (ranging from 60% to 81% of the total energy) (see Figure 1). This is not surprising as fat has twice the caloric density of protein, the latter only being used for energy once fat reserves have been depleted. Adults stored 27% more fat and 5% more protein than first-year birds, and we also found that females had 3% more protein than males. This may be explained by the fact that, on average, first-years were slightly smaller than adults, and females have higher energetic needs for egg-laying in spring.

Fat mass was correlated with fresh weight ($r = 0.71$, $P < 0.001$), and both increased as mean temperature in the seven days prior to shooting became colder (see Figure 2). Consequently, birds sampled in Scotland were heaviest and had the highest average energy reserves, with those in Cornwall being the lightest with the lowest energy reserves. In Cornwall, woodcock had 10% more energy reserves in 2013/2014 compared with birds sampled in the same location in 2014/2015. Birds in Cornwall typically carry sufficient reserves to enable them to fly 650 kilometres (km) or sit out harsh weather from three to six days, whereas woodcock in Scotland, where there are typically lower temperatures and a higher risk of cold spells, tend to have reserves permitting them to fly up to 800km or survive about three to eight days without feeding.

The next stage of this study is to examine weights of birds within our large ringing datasets to understand the seasonal build-up and change in woodcock energy reserves. Recaptures of birds within a few days of ringing should also enable us to estimate the rates at which woodcock deposit or burn up fat reserves in relation to prevailing weather conditions. With information from other sources, such as our radio-tracking studies, we aim to understand their decision-making with the onset of cold weather and be in a position to provide better advice to shoots on when it is sensible to stop shooting.

KEY FINDINGS

- Energy reserves in woodcock are related to the prevailing weather, with higher energy reserves associated with colder temperatures and more northerly locations.
- Adult woodcock typically store higher amounts of fat and protein than first-year birds, with fat providing the majority of energy reserves.
- In the event of a 'cold spell' in Britain, woodcock, on average, should be able to fly over 700km or withstand frozen conditions without feeding for five days.

Carlos Sánchez-García
Andrew Hoodless

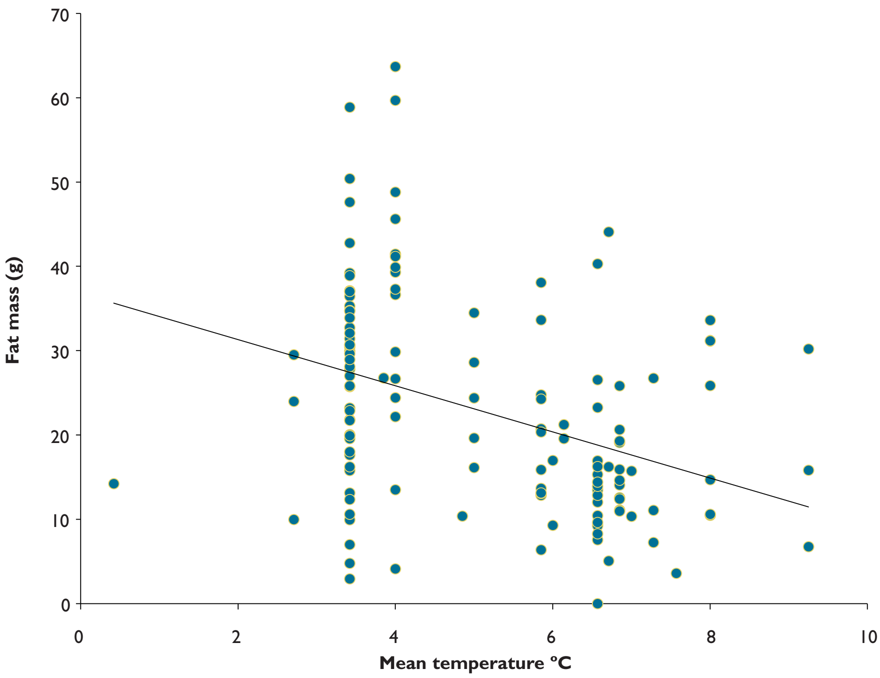


Figure 2

Fat mass is correlated with mean temperature recorded in the seven days prior to shooting

ACKNOWLEDGEMENTS

We are grateful to everyone who collected birds for this study and to Alex Fall, Joel Brittain, Arturo Oliver, José Moreno, Chris Heward and Alice Deacon who assisted with dissections. Thank you to all the estates that hosted our ringing activities and to Owen Williams of the Woodcock Network, for the use of his ringing data.

Partridge Count Scheme

Poor weather in 2015 reduced breeding productivity and hampered PCS members' ability to carry out their counts. © Laurie Campbell

KEY FINDINGS

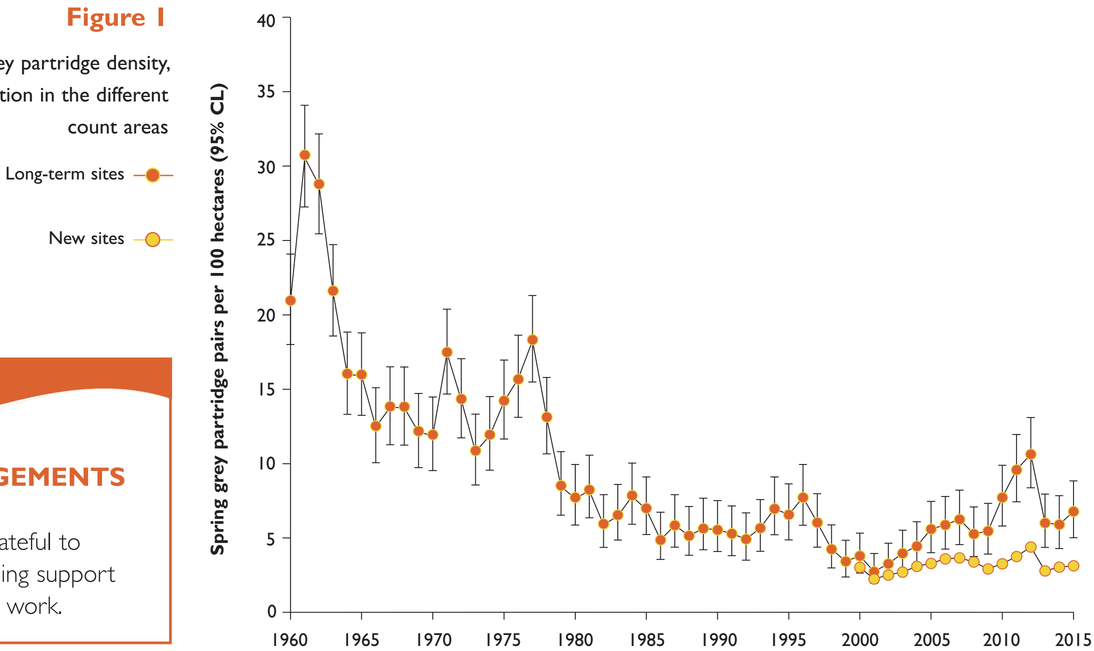
- Breeding density increased on PCS sites in spring 2015, with breeding density 3% higher on new sites and 15% higher on long-term sites.
- Grey partridge productivity was 16% lower in summer 2015 than in summer 2014. The average young-to-old (YtO) ratio was 2.1 chicks per old bird this summer, compared to 2.5 in the previous summer.
- Poor chick survival remains a major factor preventing grey partridge recovery.

Neville Kingdon
Julie Ewald

In spring 2015, Partridge Count Scheme (PCS) members returned 660 spring count forms to the scheme. A total of 8,023 pairs of grey partridges were counted, up 405 pairs (4%) on 2014. The eastern region of England remains the country's stronghold for wild grey partridges, with nearly two-thirds of pairs being recorded in that area, on less than one third of sites involved in the PCS. National grey partridge spring pair density increased again from 3.4 to 4.0 pairs per 100 hectares (ha) (+18%), but this concealed wide regional variations. Northern England pair density improved by 30%, capitalising on the high autumn densities recorded there in 2014. In contrast, southern England recorded the lowest pair density across the country.

Figure 1

Trends in the indices of grey partridge density, controlling for variation in the different count areas



ACKNOWLEDGEMENTS

We are extremely grateful to GCUSA for its on-going support of our grey partridge work.

Nationally, the 2014/15 over-winter survival (OWS) rate of 46% recorded by those in the Partridge Count Scheme was similar to that of the previous winter. This level of winter survival may be disappointing to many PCS members who are trying to increase the numbers of grey partridges on their ground. Although grey partridge recovery would be easier with better over-winter survival, our successful Grey Partridge Recovery Demonstration Project at Royston achieved 18 greys per 100ha with an average OWS rate of 42%. Unfortunately, southern England achieved only half the national figure, resulting in the region's low breeding density.

The long-term pair density index for both long-term and new sites (those joining from 1999) recorded increases again this year (see Figure 1). Overall, new sites increased their pair density by 3%, while long-term sites achieved an encouraging 15% improvement in breeding density.

The cool and damp summer of 2015 led to slow crop development and a delayed harvest. Consequently, there was a very limited window of opportunity across the country in which PCS members could undertake a grey partridge count. Despite being a challenge, 611 autumn counts were returned and although fewer in number, these counts still provide enough information to measure grey partridge productivity (see Table 1).

The area counted declined by only 1%, from 188,360ha in 2014 to 186,290ha. Nationally, bird densities decreased from an average of 19.7 to 18.7 birds per 100ha, a figure similar to the density in 2013. Although all regions recorded a reduction in bird density, the south of England had the greatest decline, with 13% fewer birds counted compared with autumn 2014.

Young-to-old ratio (YtO), a measure of breeding success, declined nationally by 16% from 2.5 to 2.1 young birds for every adult. Declines were seen across most regions but with an apparent north to south trend. Scotland recorded the largest drop from 3.1 to 2.0 (a 36% decline) while the south of England retained the same YtO of 2.1 as it had in 2014. Nationwide YtO remained above the threshold level of 1.6 needed to cover adult losses into next year, but poor chick survival remains a major factor preventing grey partridge recovery and must be addressed before densities can be expected to increase.

2015 has been a poor year for grey partridge productivity, with the indirect effects of spring and summer weather reducing breeding success and also hampering the ability of PCS members to count. Of course, these averages obscure both successes and disappointments of individual farms and shoots.

BACKGROUND

Partridge counts can offer valuable insight into how well your partridges breed, survive and benefit from your habitat and management provision throughout the year. Each count (spring and autumn) is easy to carry out and helps assess the previous six months without the need for continual monitoring. How to count:

- Record what partridges you see – using binoculars helps examine each pair or covey.
- Spring: Ensure winter coveys have split and breeding pairs have formed – typically in February and March. Record all pairs and any single birds.
- Autumn: Wait until most of the harvest has finished – ideally between mid-August and mid-September. Record adult males, adult females and young birds in each covey separately. Don't assume a covey is two adults and some young.
- In a high 4WD drive around fields and then criss-cross the whole field in a regular pattern to check the entire area using the tramlines to minimise crop damage.

www.gwct.org.uk/pcs

TABLE 1

Grey partridge counts

Densities of grey partridge pairs in spring and autumn 2014 and 2015, from contributors to our Partridge Count Scheme

	Number of sites (spring)		***Spring pair density (pairs per 100ha)***			***Number of sites (autumn)***		***Young-to-old ratio (autumn)***		***Autumn density (birds per 100ha)***	
Region	*2014*	**2015**	*2014*	**2015**	**Change (%)**	*2014*	**2015**	*2014*	**2015**	*2014*	**2015**
South	101	81	1.4	1.6	14	94	94	2.1	2.1	14.7	12
East	194	190	4.9	5.6	14	178	169	2.2	2.0	22.2	20
Midlands	140	131	3.3	3.1	-6	117	116	2.5	2.4	16.5	16.8
Wales	2	2	3.6	5.2	44	1	1	0	1.1	4.8	35.6*
North	162	158	3.7	4.8	30	155	150	2.5	2.2	26.5	25.8
Scotland	92	90	2.1	2.6	24	92	83	3.1	2.0	12.5	11.6
Overall	**690**	**652**	**3.4**	**4**	**18**	**637**	**613**	**2.5**	**2.1**	**19.7**	**18.7**

** Wales includes one site increasing from 1-3 coveys between 2014 and 2015. The number of sites includes all those that returned information, including zero counts. The young-to-old ratio is calculated from estates where at least one adult grey partridge was counted. The autumn density was calculated from estates that reported the area counted.*

The Rotherfield Demonstration Project

In 2015, grey partridge spring pairs were at their highest number since the project began. *© Markus Jenny*

KEY FINDINGS

- In 2015, the number of grey partridge spring pairs was 29 pairs, the highest number since counting began in 2004, when there were none.
- However, across the whole estate, only seven pairs produced a meagre 29 young, presumably because of low insect numbers during the breeding season.
- On the Trust side, the total number of songbirds of conservation concern has increased 2.3-fold since 2010.

Francis Buner
Malcolm Brockless
Nicholas Aebischer

The Rotherfield Demonstration Project was launched in 2010 with the ambitious aim of re-establishing grey partridges where they had become extinct and to demonstrate how this can be achieved on semi-optimal partridge land that is typical for large parts of lowland Britain. Additionally, we aimed to show how implementing all the management actions needed to restore grey partridges benefits other game and wildlife, such as farmland songbirds.

As a consequence of the project's breakthrough in re-establishing grey partridges from zero (see *Review of 2014*), 2015 started with a very promising spring count, with the highest numbers of grey partridge and red-legged partridge spring pairs recorded since the project began. Wild pheasant numbers also increased across the estate (see Table 1). Unfortunately our high hopes of building on 2014's success – when across the estate just over 100 grey partridges were counted in September – ended with frustrating numbers in our 2015 autumn count. Only seven grey partridge broods could be found, totalling a meagre 29 young. Similar disappointing breeding results were recorded for the red-legged partridges and pheasants, with lower stock densities of both species in 2015 than in 2014.

The lapwing recovery also slowed down, with only four fledglings recorded from five pairs, compared with a record 14 from 12 pairs in the previous year. We explain the poor breeding season as being a result of the prolonged cold spring, which seems to have depressed insect numbers. Nevertheless, autumn stocks of all gamebirds were up compared with the baseline year of 2010 (see Table 1).

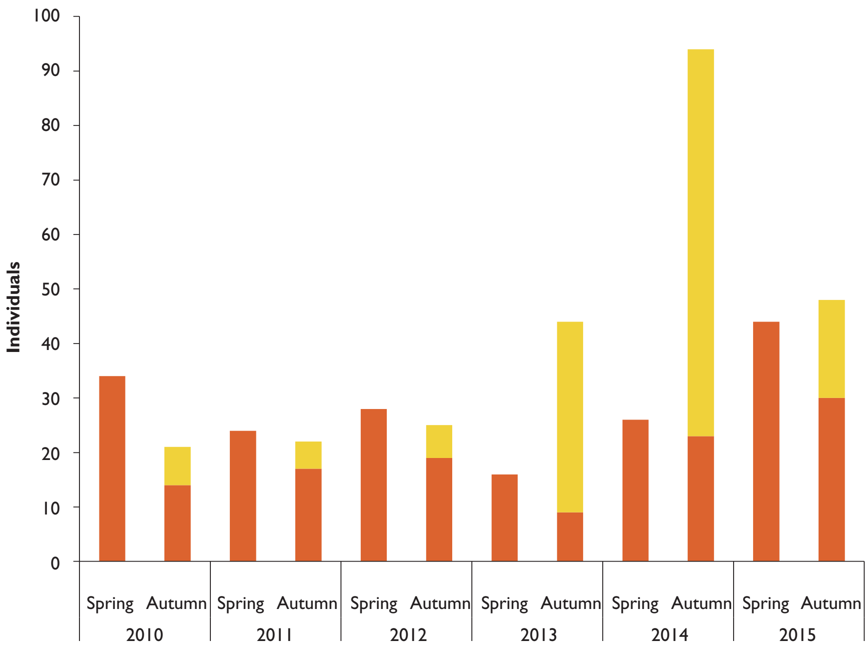
Farmland songbirds are an additional indicator group that we monitor to establish whether other wildlife species benefit from grey partridge recovery. Farmland birds are counted along 10-kilometre transects in March, April and June, which provides us with species abundance indices.

Figure 1

Number of grey partridges on the Trust side

Old

Young



Provision of sufficient high quality habitat is key for any wild grey partridge recovery. © Francis Buner/GWCT

TABLE 1

Gamebird recovery at Rotherfield, split between the Trust and Estate side (The data of 2015 are compared with levels at the start of the project in 2010)

Year		Spring pairs		Autumn stock	
		Trust	Estate	Trust	Estate
Grey partridge*					
2015 (2010)		22 (17)	7 (7)	48 (21)	20 (22)
Red-legged partridge					
2015 (2010)		37 (26)	53 (9)	116 (55)	67 (44)
Pheasant**					
2015 (2010)	Hens	220 (171)	135 (100)	348 (159)	174 (127)
	Cocks	147 (98)	133 (88)		

**In 2010 none of the grey partridge spring pairs were wild, whereas in 2015 77% were wild on the Trust side and 57% on the Estate side. **For pheasants, the number of hens and cocks in spring is shown separately, autumn stock is the number of cocks, hens and young combined. On the Trust side, 600 cock pheasants are released every August since 2011 which are not included in autumn stock numbers (for more details see Annual Reviews since 2010).*

Songbirds of conservation concern have increased 2.3-fold in total number since 2010 on the Trust side. © Peter Thompson/GWCT

BACKGROUND

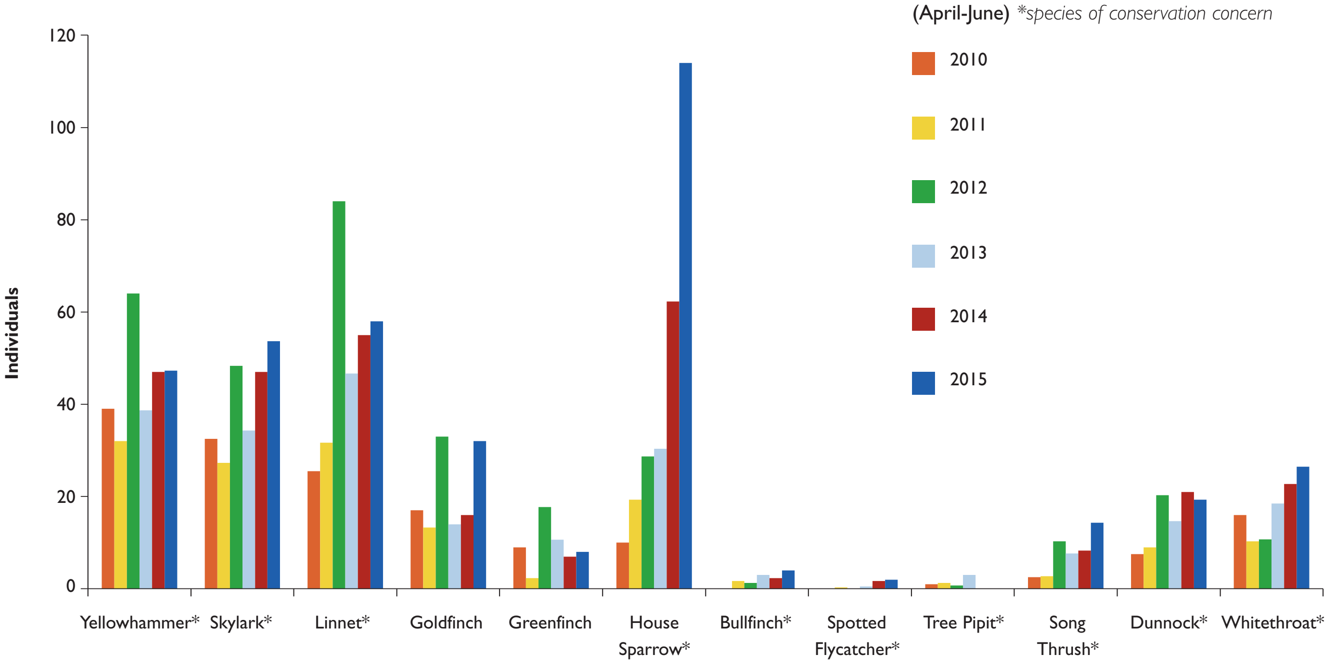
The project started in 2010 and demonstrates grey partridge recovery from zero, together with the benefits for other wild game and wildlife. It aims to be applicable to a wide range of landowners and other stakeholders wishing to recover grey partridges where they have gone extinct. Grey partridge reintroduction is based on GWCT guidelines, which follow international principles.

Since the project began, the total number of farmland birds of conservation concern that are found breeding in the Trust area has increased 2.3-fold (see Figure 2). Somewhat surprisingly, the biggest winner is the house sparrow, which has increased 11.4-fold. However, some of this increase might be due to improved monitoring at their colonies (sparrow numbers are difficult to count). The species with the second-highest increase is the song thrush (5.7), followed by a 2.6-fold increase for dunnock, 2.3 for linnet, 1.9 for goldfinch, 1.7 for skylark, 1.6 for whitethroat and 1.2 for yellowhammer.

Greenfinch numbers had doubled by 2012 but have since fallen back to 2010 levels, mirroring the national trend. Bullfinch and spotted flycatcher continue to be recorded at low but stable levels, whereas the tree pipit sadly disappeared from the Trust side in 2015. In summary, farmland birds in the project area show an encouraging general increase, whereas nationally they keep declining.

Figure 2

Annual numbers of 12 farmland songbird species counted on the Trust side along a 10-km transect during the 2010-2015 breeding seasons (April-June) **species of conservation concern*



Climate change and the Sussex Study

(Top) Conservation headlands provide excellent habitat for chick-food insects. © Peter Thompson/GWCT

KEY FINDINGS

- Eleven of the 22 most common cereal invertebrate groups of the Sussex Study were sensitive to extreme weather events, increasing in abundance following hot/dry years and decreasing following cold/wet years.
- Cereal invertebrates were very resilient to these extreme weather events. For most groups studied, abundance returned to the long-term trend within 1.5 years.
- Long-term declines in invertebrate abundance are related to an increase in the intensity of pesticide use, not to trends in either temperature or rainfall.
- Land managers can minimise the impacts of pesticides and provide habitats for chick food insects to mitigate detrimental effects of climate through the implementation of conservation headlands and other habitat manipulations.

Julie Ewald
Christopher Wheatley
Steve Moreby
Nicholas Aebischer

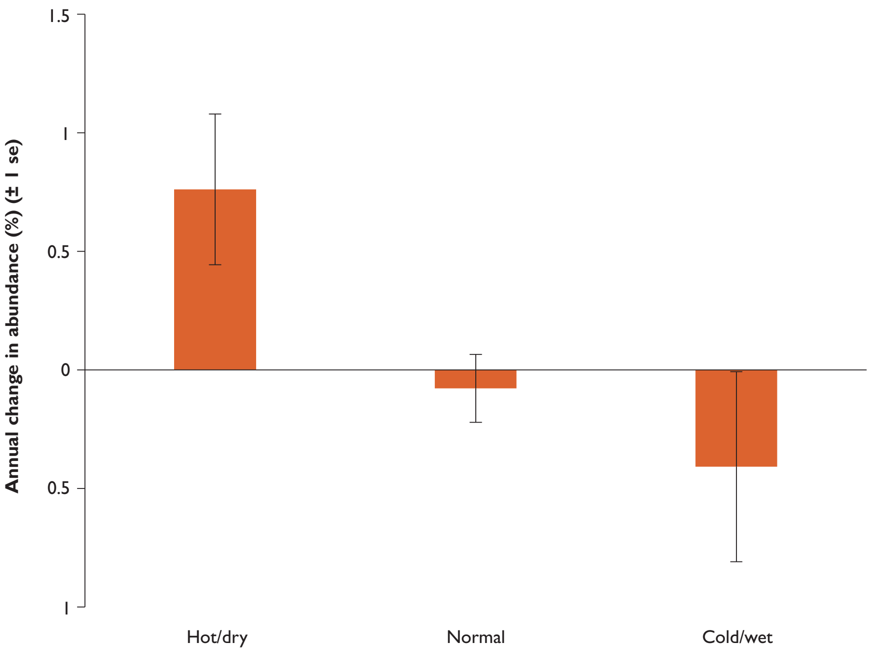
Climate change is predicted to be an exacerbating factor in many of the challenges that face UK agriculture over the coming decades. Rising temperatures and changes in rainfall patterns, together with an increase in the frequency and intensity of extreme weather events are all likely to affect cereal production and, consequently, the biodiversity associated with the cereal ecosystem. The Sussex Study is unique in providing the means to look at the effects of both extreme weather events and changing weather patterns on fluctuations in the abundance of invertebrates in the cereal ecosystem over the past 42 years. Here we consider two questions:

- Are major changes in the annual abundance of invertebrates in cereals associated with extreme climatic factors such as droughts?
- Do long-term trends in the annual abundance of invertebrate families in cereals over 40 years correlate with weather? If so what is the relative importance of changes in weather and increases in agricultural intensification?

We used published weather data from 1970 to 2011 (Met Office, UKCP09) to identify years with extreme weather from April through to June. We considered both

Figure 1

Across 42 years of the Sussex Study, leafhopper abundance increased following hot/dry years and fell following cold/wet years



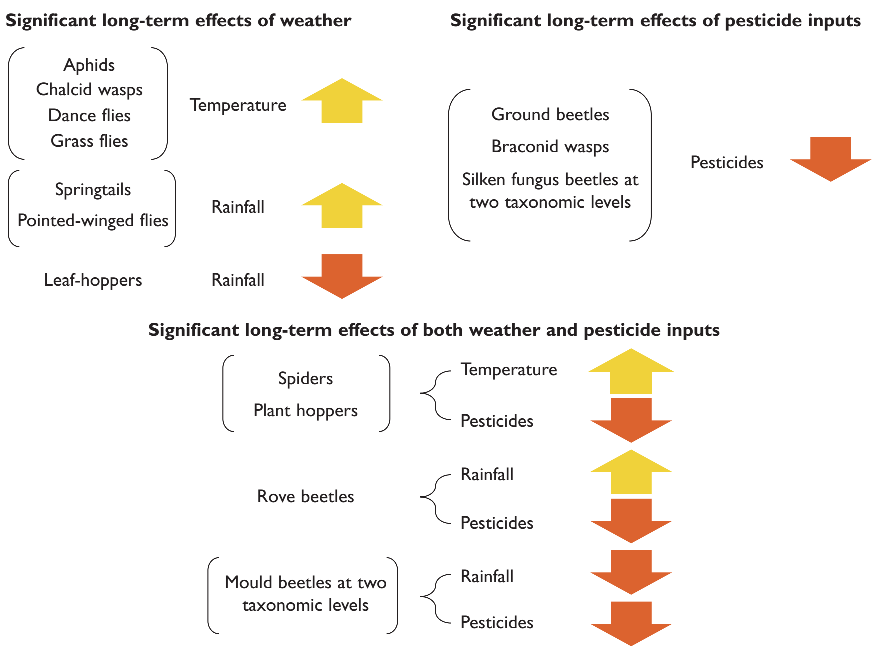


Figure 2

Long-term effects of weather and pesticide intensity on trends in invertebrate abundance. In general pesticide intensity was more damaging to invertebrate abundance than long-term changes in weather. The groups investigated included important chick-food items (aphids, spiders, plant hoppers and ground beetles) and natural predators of cereal pests (chalcid and braconid wasps and spiders)

hot/dry and cold/wet events. Hot/dry events occurred in six years (1976, 1984, 1989, 1995, 2007 and 2008) and cold/wet ones in four years (1972, 1986, 1991 and 1996). We compared changes in the abundance of 26 of the most common invertebrate groups found in Sussex in the hot/dry, cold/wet and non-event years to determine whether these invertebrates were sensitive to the weather events. Of the 22 invertebrate groups examined, 11 proved sensitive to extreme weather events. The general pattern across the groups was for abundance to increase in hot/dry years and decrease in cold/wet ones. As an example, Figure 1 shows these relationships for leafhoppers. However, the effect did not last long. On average the abundance of all 11 groups returned to their long-term trend within one and a half years of the extreme event. This is perhaps not surprising as cereal invertebrates live in an ephemeral environment. Crops are established, grow, ripen and are harvested within less than 12 months and invertebrates living in them must be able to respond to these changes quickly.

Over the 42 years of the Sussex Study considered here, the average daily temperature from April to June increased, whereas there was no pattern in the average monthly rainfall. Compared with the first five years (1970-1974), the average temperature had increased by 1.5°C in the last five years (2007-2011). The intensity of pesticide use on the Sussex Study area, measured as the number of herbicide, fungicide and insecticide applications per season, has also increased (see *Review of 2014*, page 30). The long-term trends in abundance of 16 of the 22 invertebrate groups were related to average daily temperature or average monthly rainfall from April to June. In most cases abundance increased with increasing temperature and declined with increasing rainfall. Annual abundance of 11 invertebrate groups was significantly negatively related to the yearly intensity of pesticide use across the Sussex Study area, similar to the response we have shown for chick-food insects (see *Review of 2014*).

Considering pesticide use and changes in weather, four invertebrate groups showed a significant negative relationship with pesticide use with no effect of weather, seven showed a significant relationship with temperature or rainfall but not pesticide use, and six of these were a positive relationship, while six invertebrate groups showed a significant negative relationship with pesticide use and a significant relationship with one weather variable (see Figure 2). The conclusion from this is that over the last 42 years in Sussex, changes in agricultural management (specifically increasing intensity of pesticide use) have had more of a detrimental effect on the abundance of cereal invertebrates than changes in weather variables. This underlines the need to reduce the effect of pesticides, particularly insecticides, to conserve cereal invertebrates, including chick food insects and natural predators of cereal pests, both of which are important providers of ecosystems services.

BACKGROUND

The GWCT's Sussex Study is the longest-running cereal ecosystem monitoring exercise in the world. The study has monitored both the cereal ecosystem and the farming decisions on 3,200ha of the Sussex Downs since 1970, collating information on cropping, pesticide use, cereal weeds and invertebrate abundance. This unique dataset allows us to assess the long-term changes in crop management and the effects of these changes on cereal ecosystem biodiversity.

ACKNOWLEDGEMENTS

We are extremely grateful to Natural England for funding the analysis for this work. We would like to thank all of the farmers, land managers and gamekeepers who have allowed us access to their land and shared their management information with us – the Sussex Study could not exist without their support.

National Gamebag Census: woodcock, woodpigeon and pests

Eastern breeding woodcock populations appear stable. © Chris Heward/GWCT

BACKGROUND

The National Gamebag Census (NGC) was established by the GWCT in 1961 to provide a central repository of records from shooting estates in England, Wales, Scotland and Northern Ireland. The records comprise information from shooting and gamekeeping activities on the numbers of each quarry species shot annually ('bag data').

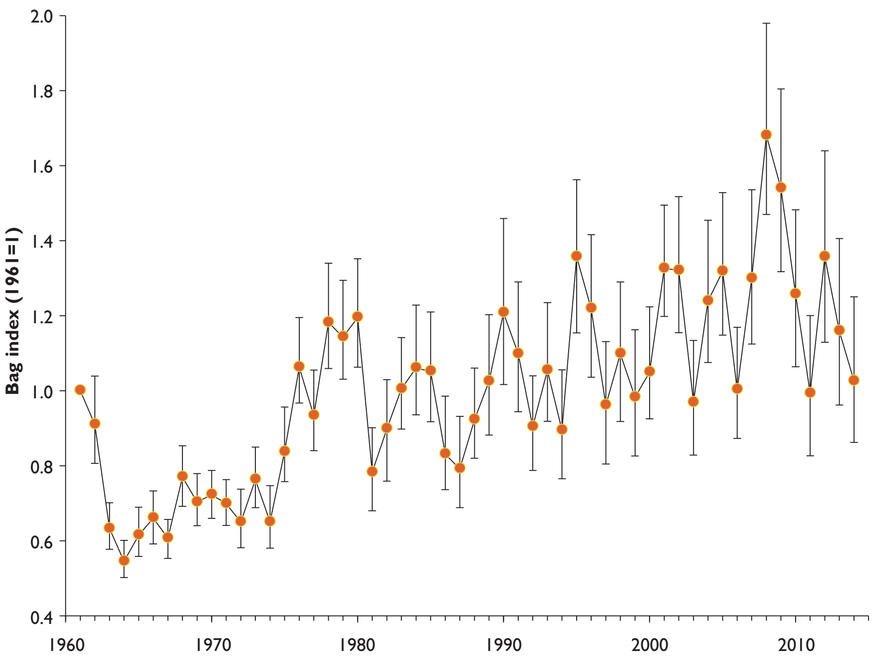
Bag records provide a historical perspective not only on shooting, but also on the underlying abundance of the target species. Here we examine the trends in bags for two commonly shot non-gamebird species, woodcock and woodpigeon, and three animals often culled as pests: crows (combining carrion and hooded), magpie and grey squirrel. We have collected bag information by mailing questionnaires to some 900 contributors to the National Gamebag Census (NGC) at the end of each shooting season. Participation in the NGC is voluntary, and we are most grateful to all the owners and keepers who send in their returns each year. For each species, we base the trend analysis on sites that have returned records for two or more years. The analysis summarises the year-to-year change within sites as an index of change relative to the start year 1961. In the graphs, this means that the first point is always set to a height of 1. A height of 2 indicates a doubling and a height of 0.5 a halving of bags since 1961.

Woodcock (Figure 1)

Since 1961, a total of 1,559 sites across the UK have provided records of woodcock bags. Woodcock shot in winter in the UK originate mainly from Scandinavia, the Baltic states and Russia, so variation may be linked to reproductive success overseas or the extent of migration. Bags slumped after the terrible 1962/63 winter, which devastated woodcock numbers across Europe. The increase observed during the 1960s and 1970s reflects the recovery of the species as its European population rebuilt itself. Since then, the long-term trend in numbers shot seems to have increased slightly in

Figure 1

Index of the numbers of woodcock shot per square kilometre in the UK, 1961-2014



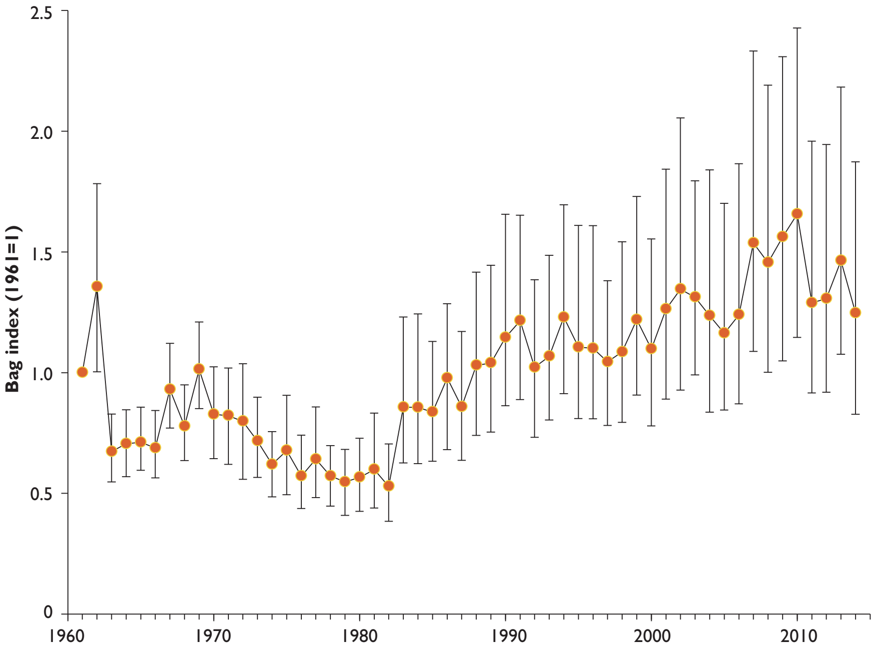


Figure 2

Index of the numbers of woodpigeons shot per square kilometre in the UK, 1961-2014

the mid-1990s, then stabilised for the last 20 years, despite marked year-to-year fluctuations. The unusual peaks in the index in 2008/09 and 2009/10 correspond to periods of extreme cold on the continent, which probably pushed more wintering woodcock than usual into the British Isles. The apparent recent long-term stability matches the results of a joint Franco-Russian monitoring scheme, which suggests that eastern breeding populations are stable.

Woodpigeon (Figure 2)

Woodpigeons are often regarded as the poor man's gamebird because, as an agricultural pest, they are frequently shot by farmers, farm workers and helpers willing to protect crops in exchange for free shooting. The NGC contains records of woodpigeon bags from 1,450 sites. Numbers shot dropped sharply following the harsh 1962/63 winter, then continued to decline slowly until around 1980, when they were half those in 1961. The trend reversed after 1980, with a steady increase until 2010 leading to a tripling of bags over 30 years; since then, they have dropped by a quarter. The pattern can largely be explained by food availability over winter. In the early years, clover was crucial to over-winter survival, and the gradual decline in ley rotational farming reduced clover availability during the 1960s and 1970s. The subsequent recovery was due to the increasing importance of oilseed rape as a break crop, especially with the development and rapid uptake of high-yielding winter varieties, which provided an alternative to clover. The drop since 2010 corresponds to an outbreak of parasitic disease, with nearly half of woodpigeons sampled in south-east England in 2011 found to be suffering from trichomoniasis.

KEY FINDINGS

- Woodcock bags have been stable for the last 20 years following a slow recovery after the 1962/63 winter.
- Woodpigeon bags declined with the abandonment of rotational ley farming, then recovered as winter oilseed rape provided readily available winter food.
- Since 1961, bags of magpies and crows have doubled and quadrupled respectively, with a stabilisation after 1990 that matches the introduction of the Larsen trap.
- The cull of grey squirrels has doubled over the last 20 years as the species' abundance and range have increased.

Nicholas Aebischer

Winter oilseed rape provides readily available food for woodpigeons. © David Mason

Magpie numbers have stabilised since around 1990.
© Laurie Campbell

Magpie (Figure 3)

The magpie is an omnivorous species that is encountered most frequently on lowland farmland. It spends much of its time foraging for insects in pasture, but readily takes bird eggs and nestlings during the breeding season. The magpie can be shot and trapped all year round under the terms of General Licences renewed annually. The trend (calculated using bag returns from 1,228 sites) shows a spectacular five-fold increase in the bag index between 1961 and 1991. Thereafter numbers culled fell back by 20% and then stabilised at a level four times higher than that recorded in the early 1960s. The 1991 peak corresponds to the widespread deployment of Larsen traps by gamekeepers and wildlife managers after they were approved for use in 1990. The national trend estimated by the British Trust for Ornithology (BTO) shows a matching rise in abundance followed by stabilisation since around 1990. The increase may be linked to the exploitation of man-made food in urban and suburban environments, but the stabilisation suggests that the Larsen trap may have had an effect at the national as well as the local scale.

Figure 3

Index of the numbers of magpies culled per square kilometre in the UK, 1961-2014

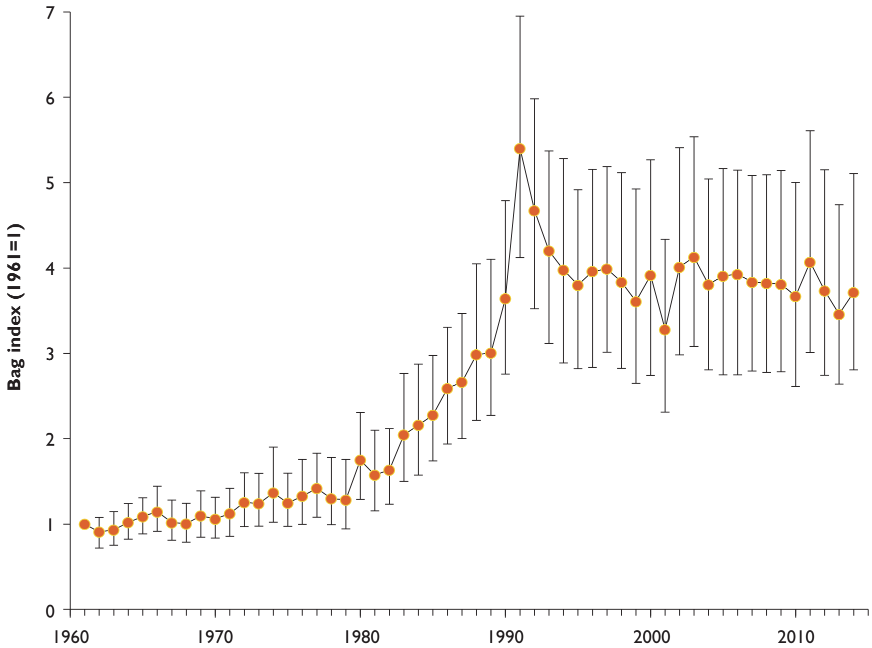
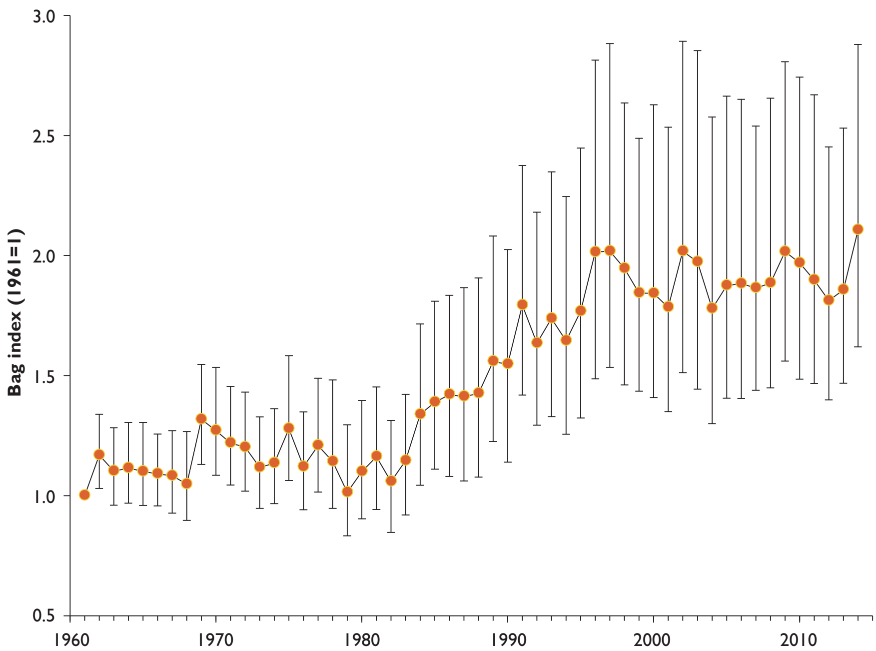


Figure 4

Index of the numbers of carrion and hooded crows culled per square kilometre in the UK, 1961-2014



Carrion crow. © Peter Thompson

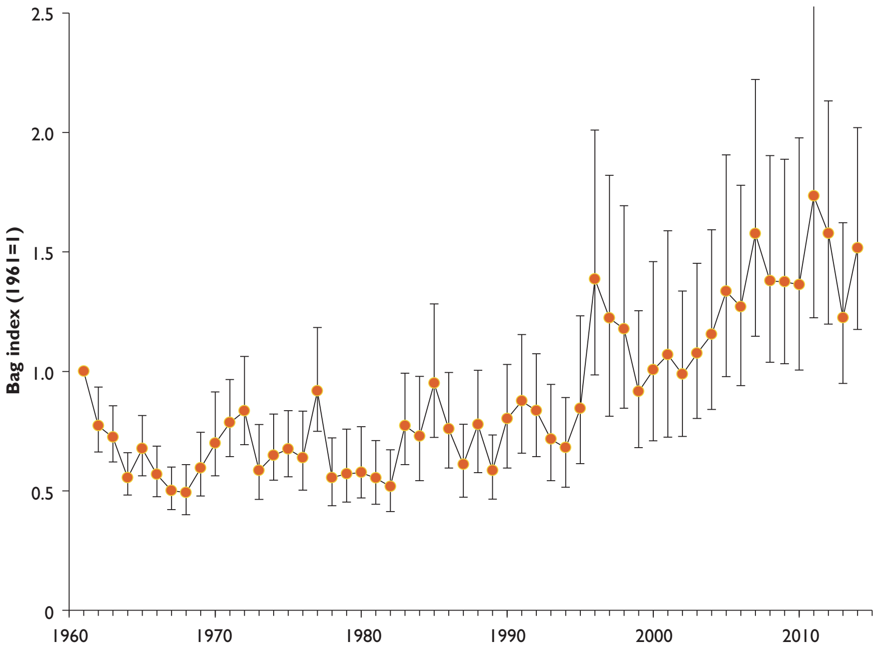


Figure 5

Index of the numbers of grey squirrels culled per square kilometre in the UK, 1961-2014

Carrion and hooded crow (Figure 4)

The carrion crow and hooded crow have been considered conspecific in the past and were not always separated in historical NGC returns. The two species have therefore been combined across 1,366 sites for trend production. Crows are omnivorous, occur across all habitat types, and are predators of ground-nesting birds, eating both eggs and chicks. Like magpies, they can be shot and trapped all year round under the terms of annually renewed General Licences. Since 1961, the numbers culled have increased overall, with a doubling between 1980 and 1995, and a period of approximate stability since 1995. The national trend estimated by the BTO indicates a similar or even greater increase in abundance between 1966 and 2013. Since 1990, crows have also been targeted by Larsen trap users, and it is perhaps no coincidence that the crow index has stabilised in the same way as the magpie index in recent years.

Grey squirrel (Figure 5)

The grey squirrel was introduced from the USA to numerous places in England, Wales and Scotland between 1892 and 1938. It spread rapidly across England and Wales, and is now expanding across Scotland and Northern Ireland. As a major invasive species responsible for red squirrel declines across the UK and damage to forestry, it may be culled year-round. Based on returns from 1,103 sites, numbers culled remained approximately stable between 1961 and the mid-1990s, then doubled over the next 20 years. Increases were most marked in East Anglia, northern England and Scotland. At the same time, the number of sites reporting grey squirrels to the NGC also doubled. These changes reflect the on-going range expansion and increasing abundance of the species, as well as renewed efforts to remove grey squirrels to conserve or reintroduce red squirrels.

NATIONAL GAMEBAG CENSUS PARTICIPANTS

We are always seeking new participants in our National Gamebag Census. If you manage a shoot and do not already contribute to our scheme, please contact Gillian Gooderham, the National Gamebag Census Co-ordinator, by telephone 01425 651019 or email ggooderham@gwct.org.uk

Grey squirrels are responsible for red squirrel declines and damage to forestry so they can be culled all year round. © Peter Thompson/GWCT

Uplands monitoring in 2015

Densities of red grouse in England fell for the first time since 2012. © David Mason

KEY FINDINGS

- Highest ever spring red grouse densities were recorded in England but followed by relatively low breeding success.
- Similar patterns were observed in Scottish red grouse densities.
- 2015 was a poor breeding season for black grouse in northern England following two very good years.

David Baines
Dave Newborn
David Howarth
Philip Warren
Kathy Fletcher

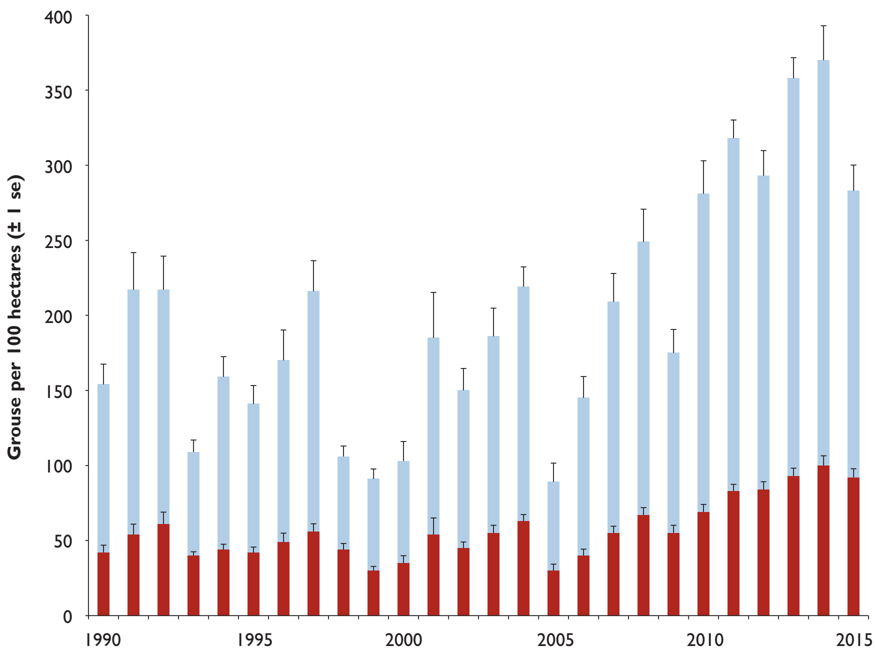
As part of our long-term work, we continue the monitoring of red grouse numbers in spring and summer. These counts are conducted in northern England and the Highlands of Scotland and take place on approximately 100 hectare (ha) blocks of heather-dominated habitat using a pointing dog.

Indices of red grouse abundance in northern England in spring 2015 had risen by 5% from the previous year, to a new record high of 120 birds per 100ha. However, the unseasonal weather in May and June appeared to impact on breeding success, which was only 2.0 chicks per adult, compared with 2.7 in 2014. With this lower chick production, July grouse indices in northern England fell for the first time since 2012 to 283 birds per 100ha (see Figure 1). It is not entirely clear what caused the reduced breeding success but inclement weather probably compromised chick survival. This decline was not universal, with some moors and in particular the North York Moors recording an increase in grouse indices from 2014 levels.

In spring 2015 in Scotland, indices of grouse abundance averaged 84 grouse per 100ha, an increase of 45% compared with 2014. Similar to northern England, grouse

Figure 1

Average index of abundance of young and adult red grouse in July from 25 sites across northern England, 1990-2015



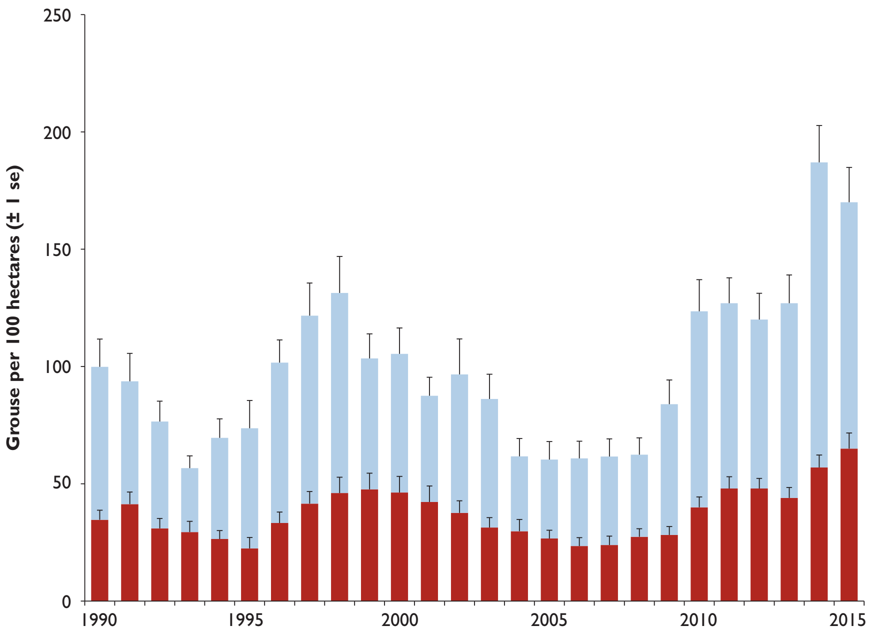


Figure 2

Average index of abundance of young and adult red grouse in July from 24 sites on Scottish moors, 1990-2015

Young grouse

Adult grouse

breeding success was poor in 2015 at 1.5 young per adult compared with 2.3 in 2014. Again, this reduction in breeding success led to 7% lower post-breeding indices of abundance of 177 grouse per 100ha in 2015 compared with 191 in 2014 (see Figure 2).

Strongyle worm burdens in England and Scotland

Worm burdens in red grouse have again remained very low across our sample sites, both in northern England and Scotland on moors that use medicated grit, where we now appear to have missed two predicted strongyle-induced grouse population crashes. The average number of worms per shot adult bird was below 100 worms for moors in both northern England (see Figure 3) and Scotland, with 30% of the adult grouse sampled containing no worms in northern England and 34% in Scotland.

BACKGROUND

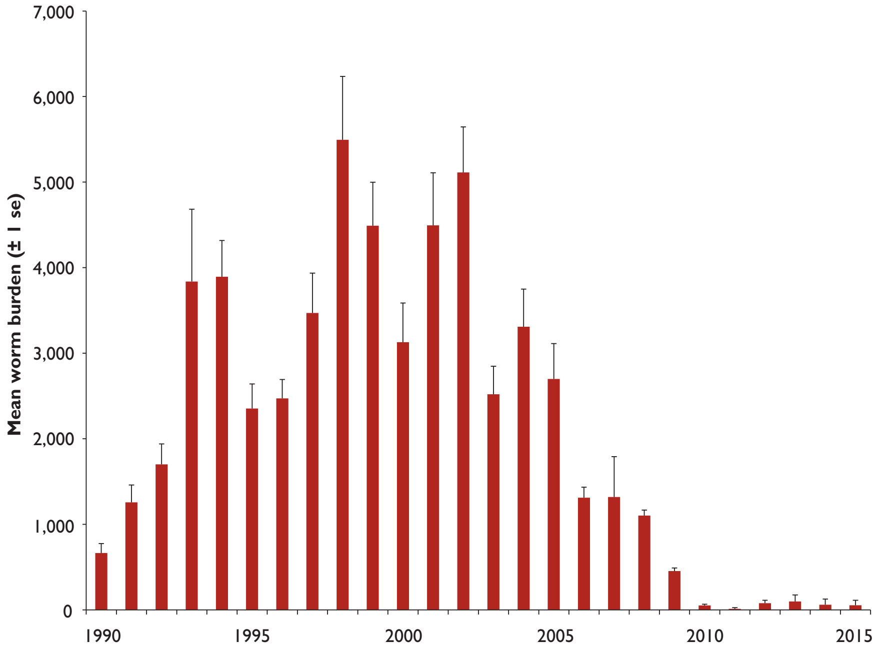
Each year our uplands research team conduct counts of red grouse in England and the Scottish Highlands to assess their indices of abundance, their breeding success and how survival may change relative to *Trichostrongylus tenuis* parasitic worm infestations. They also count black grouse cocks at their leks and estimate productivity for black grouse and capercaillie.

These data enable us to plot long-term changes so we can recommend appropriate conservation or harvesting strategies. Such information is vitally important if we are to base such decisions on accurate estimates.

Strongyle-induced grouse population crashes have not happened on moors where medicated grit is effectively deployed. © Laurie Campbell

Figure 3

Average annual *Trichostrongylus tenuis* worm burden for autumn-shot adult grouse from between 8-18 sites across northern England, 1990-2015



MEDICATED GRIT

Wise use of medicated grit remains an important issue and a best practice leaflet has been produced by the GWCT for moorland managers.
For more details visit
www.gwct.org.uk/medicatedgrit
email dnewborn@gwct.org.uk or telephone 01833 651936.

Black grouse

In spring 2015, we surveyed black grouse at 60% of known leks in northern England. The number of males attending leks was 14% up on the previous year when the national survey found 1,437 displaying males. This increase in numbers is due to good breeding success in summer 2014, when females reared an average of 2.7 chicks (see Figure 4).

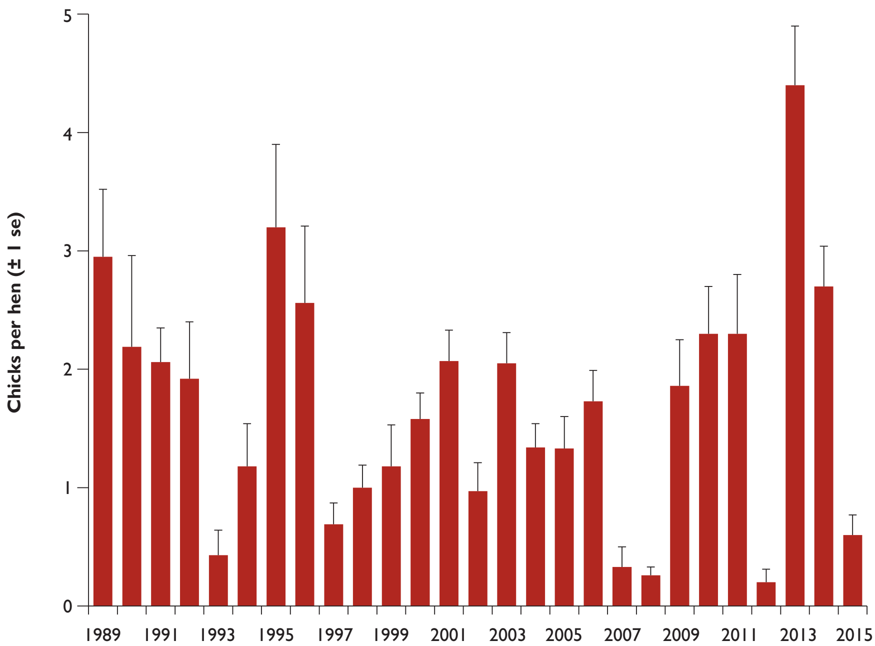
We carried out breeding surveys in northern England this summer using pointing dogs and found 63 greyhens, of which only 14 had broods, with a total of 35 chicks, an average of 0.6 chicks per hen (see Figure 4). This would have been worse but for one site where 13 hens provided 10 of the broods and 29 chicks (2.2 chicks per hen). Why this site was so good in what was a cold and wet summer requires further investigation to help us inform future management.

Capercaillie

Counts of adults and broods were conducted in four forests in Strathspey, the region which now supports an estimated 75% of Scotland's remaining population. Across

Figure 4

Black grouse breeding success in northern England between 1989 and 2015



these sites, breeding success was low, averaging 0.4 chicks per hen (see Figure 5), with 80% of hens found without a brood. Two female chicks were equipped with radio transmitters to study survival and habitat use. As we write this at the start of April, both birds are still alive and, despite only small autumnal dispersals, still remain within the forests in which they were tagged.

Overall black grouse breeding success was poor, but at one site 13 hens provided 10 of the broods and 29 chicks (2.2 chicks per hen). © Dave Kjaer

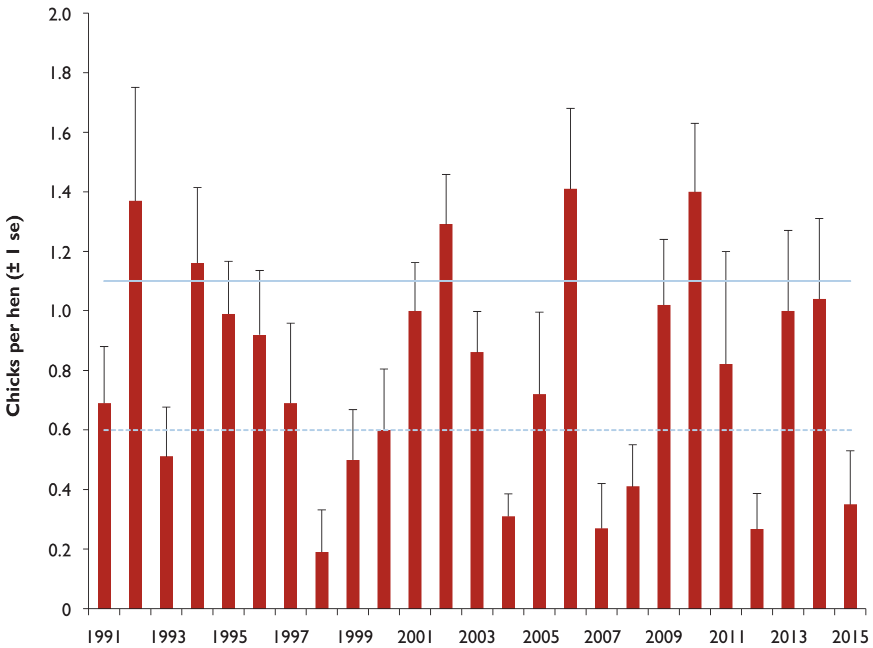


Figure 5

Capercaillie breeding success between 1991 and 2015* sampled from up to 20 forests per year in the Scottish highlands

Lines indicate levels of productivity required to maintain a stable population under different scenarios: blue solid line-with fence collision mortality; blue dashed line-without fence mortality.

** Please note that only figures for 2003 to 2009 are directly comparable as capercallie breeding success was derived from a different subset of forest areas each year before this, and since 2010 the number of forest areas surveyed has been reduced to between two and four a year.*

Breeding success was low with 80% of capercaillie hens found without a brood. © Laurie Campbell

The effect of buzzard predation on red grouse

We studied the diet of buzzards on Langholm Moor. © Richard Francksen

KEY FINDINGS

- Predation of red grouse by buzzards appears to be incidental, whereby buzzards opportunistically predate grouse while hunting for voles on the moor.
- Rates of predation by individual buzzards on grouse appear to be low, although total levels of predation could be considerable (eg. between 5-26% in spring) if buzzard numbers were high and predation was additive to other mortality.

Richard Francksen
Dave Baines

During the past 40 years, common buzzards have expanded their breeding range in Britain by an estimated 81%, and are now the most abundant diurnal raptor. Between 2011 and 2014, the Langholm Moor Demonstration Project conducted a study to explore buzzard predation on red grouse.

Part of this project was to explore how buzzards respond to annual changes in abundances of their main prey. From 2011 to 2013, we monitored changes in abundance of field voles using snap-trapping in March, lagomorphs (rabbits and brown hares) using transect counts in June/July, and red grouse using twice-annual grouse counts in spring and July.

To assess how buzzards responded to between year variation in prey abundance, we compared buzzard breeding parameters and diet composition in different years. Across all years, we collected breeding and dietary data from a total of 58 buzzard nests (46 of which yielded sufficient dietary data for analysis) found at Langholm Moor. Dietary data were collected using motion-triggered nest cameras and collection of prey remains and regurgitated pellets.

Results showed that vole abundance declined from 2011 to 2013 (mean voles per 100 trap nights: 2011 = 7.0, 2012 = 4.0, 2013 = 0.6), whereas lagomorph and red grouse abundances did not vary significantly between years. Buzzards did not appear to respond numerically to declining vole abundance: nesting density did not vary significantly between years (mean nearest-neighbour distance = 1.72km ± 0.12 SE); nor did the number of chicks fledged from all nests (mean 1.52 ± 0.11 SE). However, dietary composition data obtained from nest cameras suggested that buzzards ate more moles and shrews when vole abundance declined (percentage of deliveries containing mole/shrew: 2011 = 14.4%, 2012 = 19.9%, 2013 = 33.6%), while prey remains and pellet data suggested that buzzards ate more lagomorphs (percentage in all identified remains: 2011 = 11.9%, 2012 = 16.3%, 2013 = 23.2%). Notably, however, buzzards did not switch to eating more red grouse: no overall trend was apparent from nest camera data, while the proportion of red grouse in prey remains and pellets actually declined from 8.3% in 2011 to 4.1% in 2012 and just 2.2% in 2013. These results suggest that buzzard predation of red grouse may be incidental in nature, whereby high vole abundances encouraged buzzards to hunt in red grouse habitats.

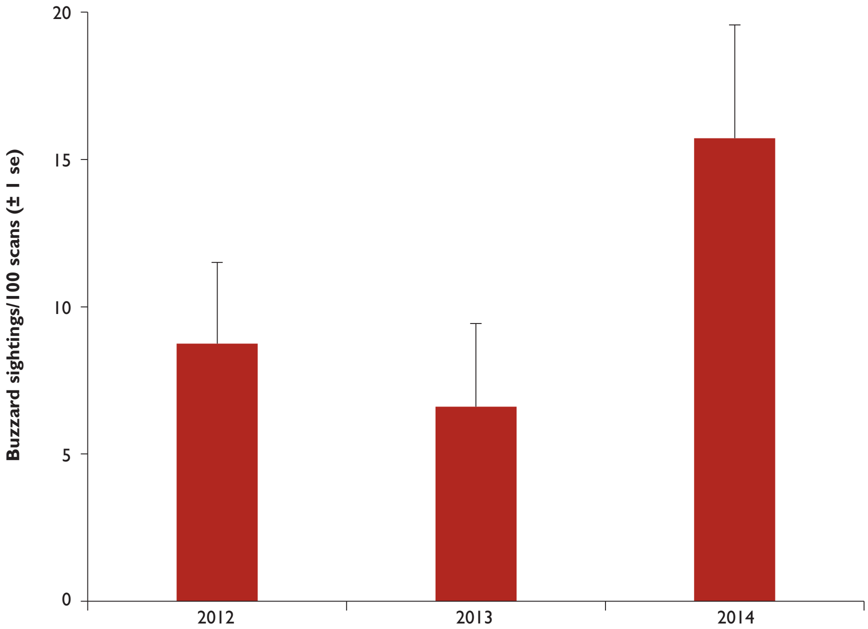


Figure 1

Index of buzzards seen hunting on Langholm Moor during three summers (May-July)

Note that 2014 was a peak year for vole abundance cycle, and 2013 was a crash year

This finding was confirmed by results from vantage point watches conducted between 2011 and 2014. In both summer and winter, we found that buzzard foraging intensity varied with annual variations in vole abundance (see Figures 1 and 2). Our analysis also showed that buzzards avoided heather-dominated areas in years when vole abundance was low, but not when vole abundances were high. This again suggests that incidental predation of red grouse by buzzards could increase when vole abundances were high.

We explored the composition of buzzard diet during the winter months, something relatively few studies have assessed in the past. We located roost sites of nine buzzards fitted with either radio or satellite tags, and an additional 14 roost sites of untagged buzzards. From all 23 roost sites we recovered 409 pellets throughout the 2013/14 winter. Buzzard winter diet was primarily composed of small mammals (77% of all

Buzzards avoided heather-dominated areas in years when vole abundance was low. © Ayla Paul

BACKGROUND

As part of the Langholm Moor Demonstration Project (LMDP), a PhD project supervised by Newcastle University was undertaken between 2012 and 2015 to better understand the relationship between common buzzards and red grouse. Specifically, the project looked at aspects of buzzard diet, foraging patterns, population, breeding parameters and home ranges to better understand the potential impact of buzzards on red grouse at Langholm Moor.

Buzzard diet was primarily composed of small mammals. © Richard Francksen

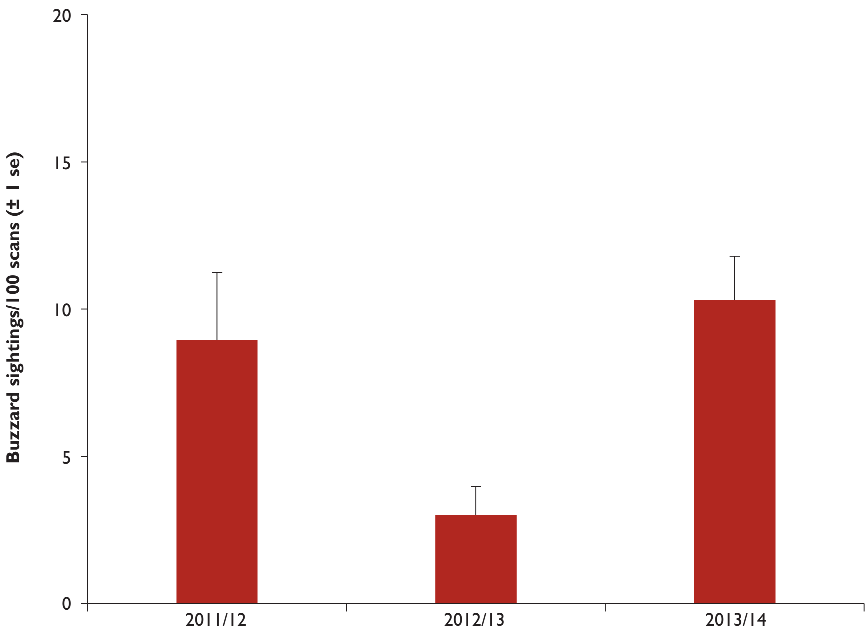
identified prey items in pellets), while red grouse comprised 1% of all identified prey items. We compared the composition of pellets to the habitat surrounding each roost, and found that red grouse remains were less likely to be present in pellets when buzzards roosted in areas with a high proportion of grassland habitats, probably because these contained higher densities of rabbits and other grassland prey groups.

By combining estimates of buzzard numbers, diet composition and energetic requirements, we were able to estimate the potential consumption of red grouse by buzzards at Langholm Moor during three summers (2011-2013) and one winter

Figure 2

Index of buzzards seen hunting on Langholm Moor during three winters (October-February)

Note that 2013/2014 was a peak year for vole abundance



(2013/14). During the summer, we estimated that 125 individual buzzards were present on Langholm Moor (including non-breeders, breeding adults and their young) and 53 buzzards were present during the winter. We calculated that the buzzards ate between 64 and 318 adult red grouse during one summer, although this estimate varied between years and method of dietary assessment. This was equivalent to buzzards eating between 5% and 26% of all adult red grouse present in spring. Additionally, we estimated that buzzards ate between 96 and 380 grouse chicks during one summer, again with variation between year and method. During one winter, we estimated that buzzards ate 384 grouse, equivalent to 11% of the total grouse present in autumn and 31% of the total number estimated to die over-winter using grouse count data. Our results suggested that while consumption of grouse by individual buzzards is low, total levels of consumption could be considerable if buzzard numbers are large enough, assuming that the mortality caused by buzzards was additive to other causes of grouse mortality.

In summary, results suggest that predation of red grouse by buzzards is incidental, linked to temporal changes in vole abundance, which affected the relative attractiveness of heather moorland to buzzards. Loss of grouse to buzzards could be considerable if numbers of buzzards were high, although further work is needed to establish whether predation by buzzards is additive to other causes of grouse mortality. Further research should investigate the effectiveness of methods aimed at discouraging buzzards from hunting in grouse habitats.

Buzzard predation of red grouse appears to be incidental. © Making the Most of Moorlands Project

Richard Franksen installing a nest camera to film buzzards. © Ayla Paul

ACKNOWLEDGEMENTS

This PhD study was supported by the Langholm Moor Demonstration Project in collaboration with Newcastle University. We are grateful to Buccleuch Estates for granting access to all the study sites.

Surveying black grouse leks in England

Black grouse male displaying at a lek.
© Dave Kjaer

KEY FINDINGS

- Numbers of black grouse increased from 773 males in 1998 to 1,437 males in 2014.
- On the southern fringe of the range in the Yorkshire Dales, numbers and range increased, in contrast to north Northumberland, where black grouse have practically disappeared.

Philip Warren
Dave Baines

BACKGROUND

Black grouse have declined in numbers and range over the past 100 years and they are now restricted to the edges of moorland in the Pennines in northern England. It is designated a 'priority species' with the aim to restore numbers in England to 1,200 males and to increase its range.

Black grouse were once common throughout England, but following a severe decline in numbers and range over the past 100 years they are now restricted to the edges of moorland in the Pennines in northern England. Following these declines, black grouse have been recognised as a species of high conservation concern, red-listed, and designated a 'priority species' of the UK Biodiversity Action Plan in 1999, with its own Species Action Plan (SAP) to restore numbers in England to 1,200 males and range to 52 occupied 10x10 kilometre (km) grid squares by 2015.

In spring 2014, we completed the fourth national lek survey of black grouse in England, following earlier surveys in 1998, 2002 and 2006. We survey black grouse by counting the numbers of males at display sites known as 'leks' at dawn in April and May to coincide with peak attendance by males. Males gather daily at leks where they defend individual territories and display to attract females. We monitor numbers by counting males, as females visit leks only to select a mate and are less frequently seen.

The results from the spring 2014 survey were encouraging, with overall numbers increasing by 86% from 773 males in 1998 to 1,437 in 2014 (see Table 1), and range by 46% from 74 to 108 occupied 5x5km grid squares (see Figure 1). This corresponds to an increase from 37 to 48 occupied 10x10km grid squares. However, despite the overall increases in numbers and occupied range, we observed contrasting fortunes

TABLE 1

Total numbers of male black grouse attending leks in four regions of northern England

Year	North Northumberland	North Pennines	Yorkshire Dales	Peak District	Total
1998	61	654	58		773
2002	101	690	103		894
2006	50	841	138		1,029
2014	2	1,241	193	1	1,437
Change (%) 1998-2014	**-97%**	**+90%**	**+233%**	**-**	**+86%**

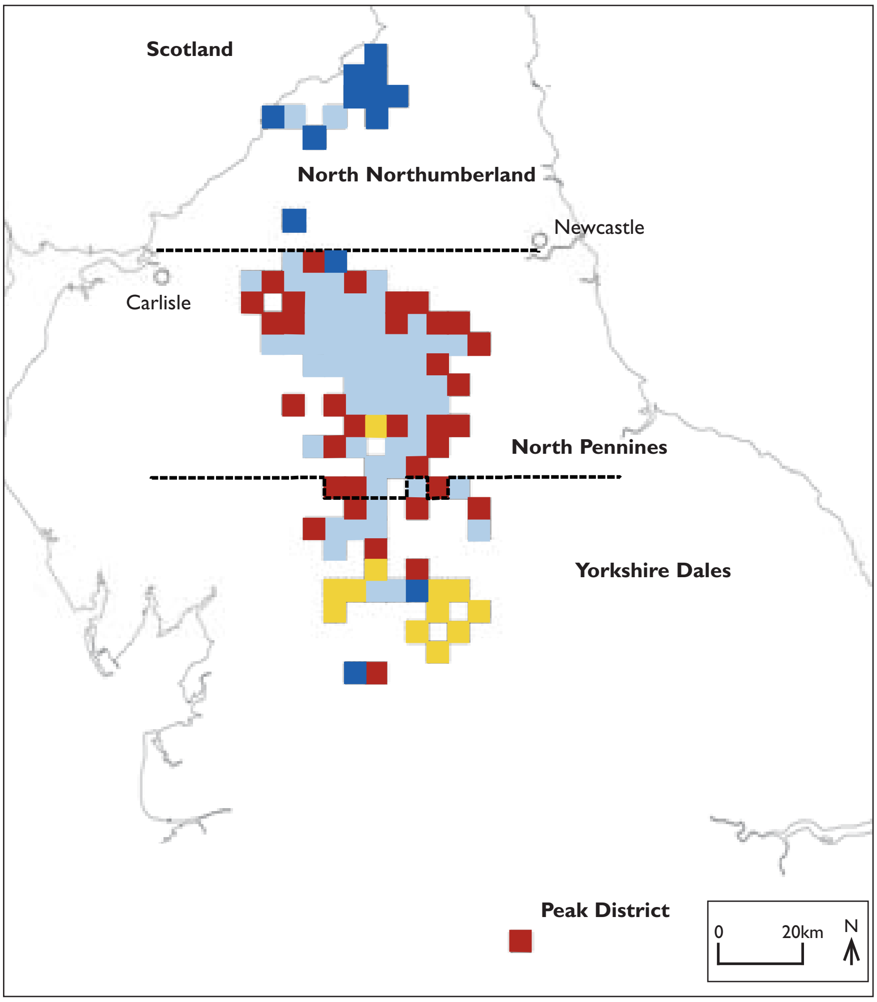


Figure 1

Changes in the distribution of black grouse in northern England 1998-2014

- Translocation
- Expansion
- Persistence
- Retraction

We count the number of male black grouse at leks in April and May. © GWCT

at the southern and northern fringes of their range. In north Northumberland, black grouse have practically disappeared, with numbers declining by 97% and range by 83%. This was in direct contrast to the southern edge of the range in the Yorkshire Dales, where numbers increased by 233% and range by 133%. Our work to expand the range in the Yorkshire Dales through translocating wild males to three sites since 2006 has contributed to this expansion, with two-thirds of newly-occupied squares in the Yorkshire Dales colonised by our translocated birds.

Since the last full survey in 2006, we have seen large fluctuations in the number of males at a sample of 60 leks counted annually linked to weather events. In spring 2010 the population crashed following high mortality during the severe winter of 2009/10. Since then, numbers have recovered, particularly following high breeding success in 2013. Warm, dry weather when chicks first hatched in June, resulted in females producing an average of 4.4 chicks each, three-fold greater than the annual average of 1.3 chicks. This led to a 77% increase in the numbers of males attending our sample leks between 2013 and 2014.

The results show that the revised SAP target of 1,200 males by 2015 has been met ahead of schedule. However, only limited progress has been made towards meeting the range targets, as the increases in the North Pennines and Yorkshire Dales have been offset by the decline in range in north Northumberland. The overall occupied range still remains restricted relative to its previous extent and is becoming increasingly isolated from the range of black grouse in the Scottish Borders. To deliver range expansion targets we have identified the priority area as south into the Yorkshire Dales. Here, the network of suitable habitats on the fringes of moors managed for driven red grouse shooting are connected at a landscape scale. Thus, to facilitate range expansion, we are working with landowners in the Yorkshire Dales to provide, enhance and re-create suitable habitats, while using translocation of wild birds as a conservation tool to expand range.

ACKNOWLEDGEMENTS

We would like to thank the Moorland Association, RSPB, Yorkshire Dales National Park Authority and Northumberland National Park Authority for funding this work. We also would like to thank those who helped to complete the surveys, including the Forestry Commission, North Cheviot Black Grouse Group, RSPB, Ministry of Defence, North York Moors National Park Authority, Peak District National Park Authority, United Utilities and moorland gamekeepers.

Langholm Moor Demonstration Project: year eight

We used pointing dogs to help us monitor red grouse chick survival. © Sonja Ludwig/GWCT

KEY FINDINGS

- A cold and wet spring, in combination with low vole numbers and increased predator indices, negatively affected breeding success of red grouse and hen harriers.
- Eight female hen harriers fledged 17 young.
- Red grouse breeding success was the lowest since the start of the project with only 1.6 chicks per hen.

Sonja Ludwig
Dave Baines

The cold and wet spring in 2015 contributed to poor breeding success in many of the moor's ground-nesting birds, in combination with a crash in vole numbers between March (4.4 voles caught per 100 trap nights) and July (0.9 voles caught per 100 trap nights) and increased predator indices (eg. three-fold increase in fox scats compared with 2014, 1.2-fold increase in crows during the Breeding Bird Surveys). Eight female hen harriers attempted to breed on the moor, of which six were successful and fledged a total of 17 young. This productivity of 2.1 young fledged per breeding female was well below the average of previous years (2008-2014: 4.2 young/female), but still higher than the national average of 1.8 young/female (2008-2014). Furthermore, only four out of 10 merlin pairs and two out of 12 short-eared owl pairs were confirmed to have fledged young, compared with four out of six merlin pairs and 10 out of 12 short-eared owl pairs in 2014.

This breeding season has also been the worst recorded for red grouse since the project started. Following a decrease in spring density, the July density also showed a marked decline with 76 grouse per 100 hectares (see Figure 1), due to a combination of increased adult mortality (39% between spring and July counts) and poor productivity (8.4 eggs per clutch, 1.6 chicks per hen – Table 1). This compares with 8.5 eggs per clutch on average at three other moors, and 3.4 chicks per hen nationally (72 moors). The density estimates were derived using distance sampling and represent the 'absolute estimated density', in contrast to indices based merely on the number of grouse seen during counts as used in the Uplands Monitoring article (see page 34). At Langholm we do both count methods; over the period of the project number of grouse derived from distance sampling has been just over double the number 'seen' during counts (mean 2.03).

To obtain more information on the main causes of clutch failure and chick mortality, we conducted intensive monitoring of grouse nests and chicks in 2013-2015. We fitted 52 grouse nests with thermologgers and dummy eggs, and 40 nests were additionally fitted with a nest camera. To monitor chick survival in the critical first three weeks after hatching, we fitted 73 chicks with small radio-transmitters soon after hatching.

Figure 1

Density of red grouse at Langholm derived from distance sampling transects

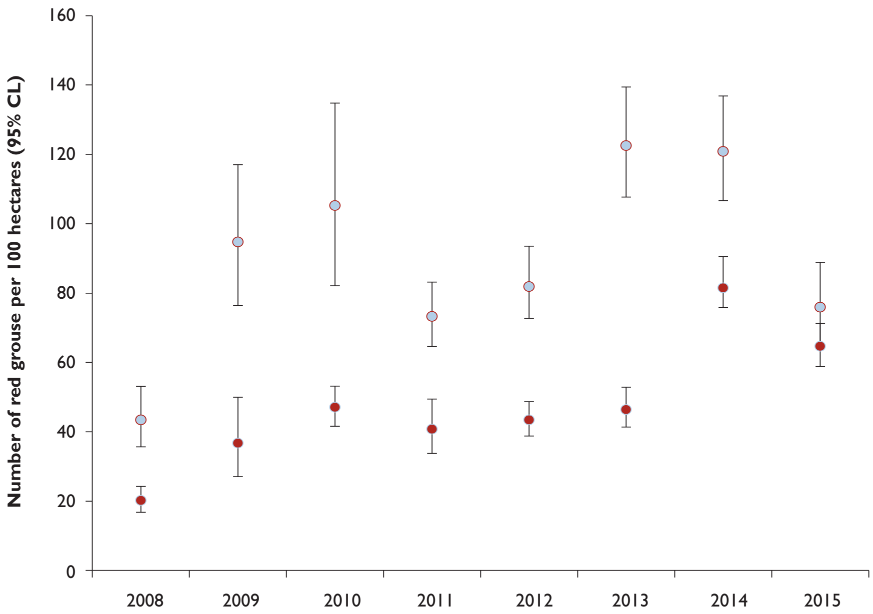


TABLE 1

Estimates for reproductive success and survival of radio-tagged red grouse hens and estimates for reproductive success derived from July counts at Langholm 2013-15

	2013	2014	2015
Radio-tagged birds			
Number of hens	*20*	*17*	*15*
Clutch size	10.1	8.7	8.4
Hatching success	0.81	0.88	0.95
Nesting success	0.90	0.71	0.67
Hen survival until July	0.95	0.65	0.60
July counts			
Number of hens	*115*	*126*	*134*
Chicks/hen	4.5	3.7	1.6
Brood size	5.4	4.6	3.0
Hens with broods	0.80	0.73	0.54

Nesting success and survival of radio-tagged hens from egg-laying until July decreased between 2013 and 2015 (see Table 1). During this time a total of 13 nests failed due to predation, the majority due to predation of the hen (9 nests), by a combination of raptors and other predators including foxes (see Table 2). No nest failed due to predation of eggs, although some clutches were predated by corvids after failure, ie. the death of the hen or desertion. In 2014 and 2015, four further hens were predated by raptors during the chick-rearing period, and one hen, which deserted her first clutch, was predated by a fox before she could re-lay.

We lost 30% of the 73 radio-tagged chicks during the lifetime of the transmitters (approximately 21 days); eight were found predated (seven by raptors, one by stoat/weasel), and for 14 we lost the signal before the end of the battery life, indicating that they were either predated and carried off, or that the tag failed prematurely. As no chicks were found dead with signs of exposure, predation appears to be the most likely cause of death.

With less than two years remaining, the project's Directors have agreed there is no realistic chance of reaching the target grouse density necessary for driven shooting, and that gamekeepering will be wound down, ending fully by April 2016. Importantly the project will carry out another full year and half of monitoring, tracking habitat quality, numbers of moorland birds and the breeding success of the hen harriers over the 2016 and 2017 breeding seasons. This will give the project time to gather further information on the beneficial effects of moorland management, while the project scientists finalise a variety of reports for the Directors to review before publication.

TABLE 2

Causes for red grouse nesting failure 2013-15

	Failed clutches (N=13*)
Hen predated by raptor	4
Hen predated by fox	2
Hen predated by unknown predator	3
Desertion	3
Failed to hatch	1

** Including one replacement clutch*

BACKGROUND

The Langholm Moor Demonstration Project (LMDP) aims to reconcile grouse moor and raptor conservation interests with the core objective of re-establishing Langholm Moor as a driven grouse moor while maintaining a viable population of hen harriers. Since 2008, the 10-year project has employed a team of five gamekeepers to manage the 12,000 hectare study area. In addition to predator control and heather management, all harriers that nest on the moor are provided with diversionary food. A detailed review of the project's achievements is available in the '*Langholm Moor Demonstration Project – Seven Year Review* – December 2014' at www.langholmproject.com.

Two out of 12 pairs of short-eared owls fledged young. © Brian Benn/GWCT

ACKNOWLEDGEMENTS

The Langholm Moor Demonstration Project is a partnership between the Game & Wildlife Conservation Trust, Scottish Natural Heritage, Buccleuch Estates, the RSPB and Natural England.

Bees and agri-environment schemes

Osmia bicolor visiting bird's-foot trefoil for nectar. This species requires unimproved grassland with plenty of snails, as it builds its nest inside their empty shells. © K McGee

KEY FINDINGS

- The creation of flower-rich areas on HLS farms increased the abundance of some bumblebee species three-fold relative to ELS farms.
- Bee diversity was strongly associated with flowering plant diversity.
- Flower-rich areas did not increase total floristic diversity and consequently did not increase bee diversity.

Thomas Wood
John Holland

BACKGROUND

Agricultural intensification has reduced the abundance and diversity of many flowering plants in farmland habitats. To address this, flower-rich agri-environment schemes have been designed to put flowers back into the countryside. This project aims to measure how these schemes benefit bumblebees and other wild bees on farmland.

During the 20th century there have been major declines in farmland biodiversity, and bees are no exception. The change in the distribution of bumblebees has been most apparent, with two of the 25 species native to Britain becoming extinct and a further eight showing serious declines. These declines have been linked to agricultural intensification, including the loss of flower-rich low-intensity grasslands such as hay meadows, which have either been ploughed up or converted to high-fertiliser input silage grassland. This subsequent reduction in floral abundance and diversity has negatively affected species that are dependent upon pollen and nectar.

To address these declines, a number of agri-environment scheme (AES) options have been introduced that aim to increase floral abundance and diversity within farms. These predominantly take the form of permanent (see page 47) or rotational (see page 48) floristically-enhanced margins that are sown alongside the edges of fields. Whole-field options for longer-term grassland management and restoration also exist (see page 49), but they are less commonly adopted.

This project assessed whether the provision of additional floral resources had a positive effect on local bumblebee abundance and on the diversity of the bee community as a whole. We selected nine Higher Level Stewardship (HLS) farms implementing an average of 5.5 hectares (ha) of flower-rich AES and nine Entry Level Stewardship (ELS) farms not implementing any flower-rich AES across Hampshire and Sussex, and surveyed the farms during the 2013-15 seasons.

The effect of additional floral resources on bumblebee abundance

We assessed bumblebee abundance along three kilometre (km) transects walked three times annually (early, mid and late-summer) across each farm in 2013 and 2014. Almost twice as many bumblebees were counted on HLS farms (6,132) compared with ELS farms (3,304). However, bumblebees are highly mobile insects and are known to aggregate on patches of suitable forage in the landscape. Consequently, direct counts of individuals may not necessarily reflect the true abundance. As social insects, the number of colonies in an area is the best measure of abundance.

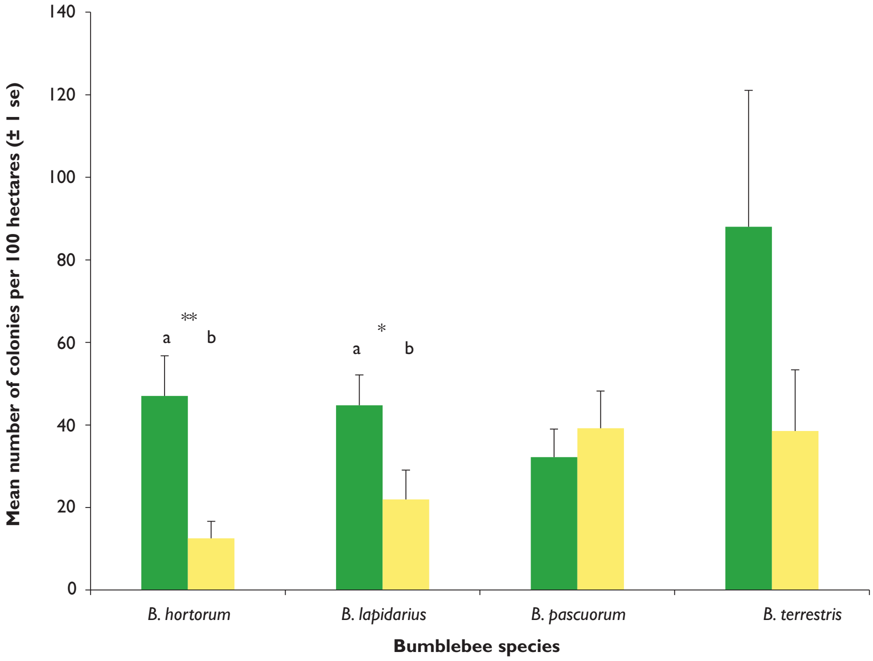


Figure 1

Differences in the nesting density of four bumblebee species between Higher Level Stewardship farms and Entry Level Stewardship farms. Different letters above columns indicate farm types, which differed significantly in a sampling round. $*p<0.05$; $**p<0.01$

Higher Level Stewardship (HLS)

Entry Level Stewardship (ELS)

Worker bumblebees produced from the same colony are sisters, and hence molecular genetic techniques can be used to identify highly related workers from the same colony. We caught worker bumblebees from four species in the field, collected a non-lethal tarsal (toe) sample and released them. This sample was then genotyped to estimate the number of colonies. The four most common social species were sampled, *Bombus terrestris* and *B. hortorum* in 2013 and *B. pascuorum* and *B. lapidarius* in 2014.

Non-rotational floristically enhanced margin (HE10) showing ox-eye daisy, bird's-foot trefoil, wild carrot and common knapweed. © Tom Wood/GWCT

Rotational nectar flower mixture (EF4) showing alsike and red clover. © Tom Wood/GWCT

Lasioglossum leucozonium *is usually found in yellow flowers, collecting the majority of its pollen from composites such as cat's-ear and mouse-ear hawkweed (pictured). © Tom Wood/GWCT*

Colony density estimates (see Figure 1) showed that there were four times more colonies of *B. hortorum* and twice as many *B. lapidarius* colonies on HLS farms than on ELS farms. There were twice as many colonies of *B. terrestris* on HLS farms, but this was not significant and there was no difference in the number of *B. pascuorum* colonies. Combining all species, HLS management significantly increased the number of colonies of common bumblebee species two-fold.

The effect of additional floral resources on bee diversity

In addition to the transect surveys described above, we also used water traps in 2013 and 2014, and placed a total of 12 traps out on each farm for a four-day period, and repeated this three times in the year. In 2015 we surveyed each farm with a three-hour time-limited transect, which was carried out in April, May, June and July.

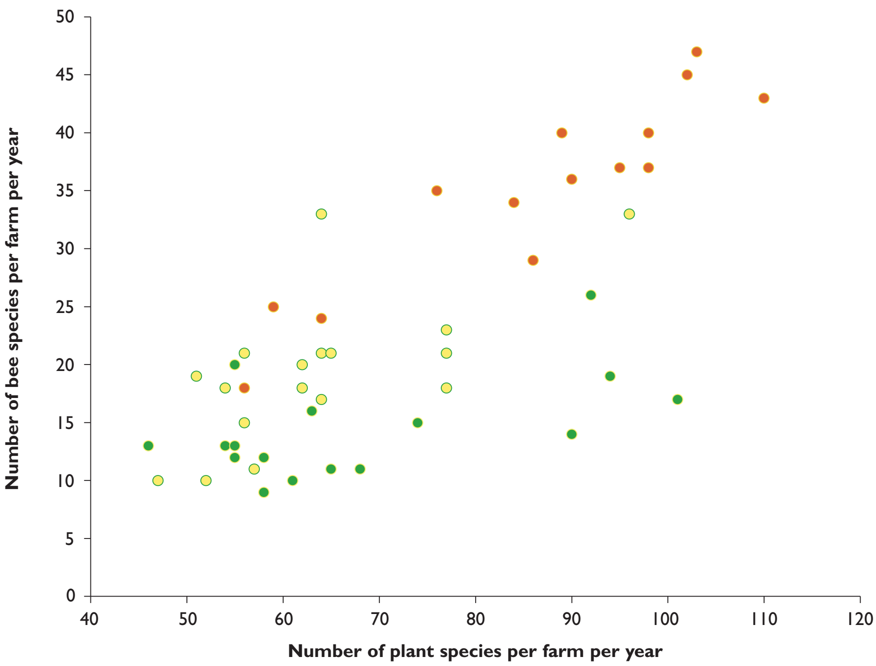
Figure 2

Relationship between the number of bee species recorded on each farm in each year against the number of flowering plant species recorded on each farm in each year. $\chi^2=33.8, p<0.001$

2013

2014

2015



ACKNOWLEDGEMENTS

This PhD study was funded by a Natural Environment Research Council grant NE/J016802/1 to the University of Sussex and by the GWCT. We would like to thank Professor Dave Goulson and all the farmers who allowed us access to their land.

Melitta haemorrhoidalis *visiting geranium for nectar. This species is highly specialised and only collects pollen from bellflowers in the genus* Campanula. *© Tom Wood/GWCT*

A total of 115 species of bee were recorded, which is over half of the 200 or so species found in the south-east of England and almost half the 250 species currently found in Britain. Twenty three species of conservation concern were recorded, including extremely rare species in the highest tier of concern. However, there was no difference in the total number of bee species found on HLS and ELS farms. More generally, bee diversity was strongly associated with the diversity of flowering plants (see Figure 2). Although the addition of flower-rich habitat increases floral and bumblebee abundance, there was no significant difference in flowering plant diversity between farm types.

Overall the creation of flower-rich habitat can provide important resources for foraging bumblebees, but it does not seem to affect the diversity of the wider bee community. Developing ways to increase floristic diversity on farmland should be pursued to complement existing management techniques.

Long-term species-rich grassland (HK7) showing white clover, greater knapweed and rough hawkbit. © Tom Wood/GWCT

QuESSA - the benefits of nature

Different coloured water traps were used to catch bees and pest natural enemies. © John Holland/GWCT

KEY FINDINGS

- Hedgerows, woodland edges and grassy strips all contained pollinators and pest natural enemies.
- Floral resources in hedgerows, woodland edges and grassy strips peaked in May whereas wild bees peaked in August.
- The floral resources of these semi-natural habitats on farmland could be improved by increasing flowering plant density and diversity.

John Holland
Niamh McHugh
Steve Moreby
Matthew Brown
Tom Elliott

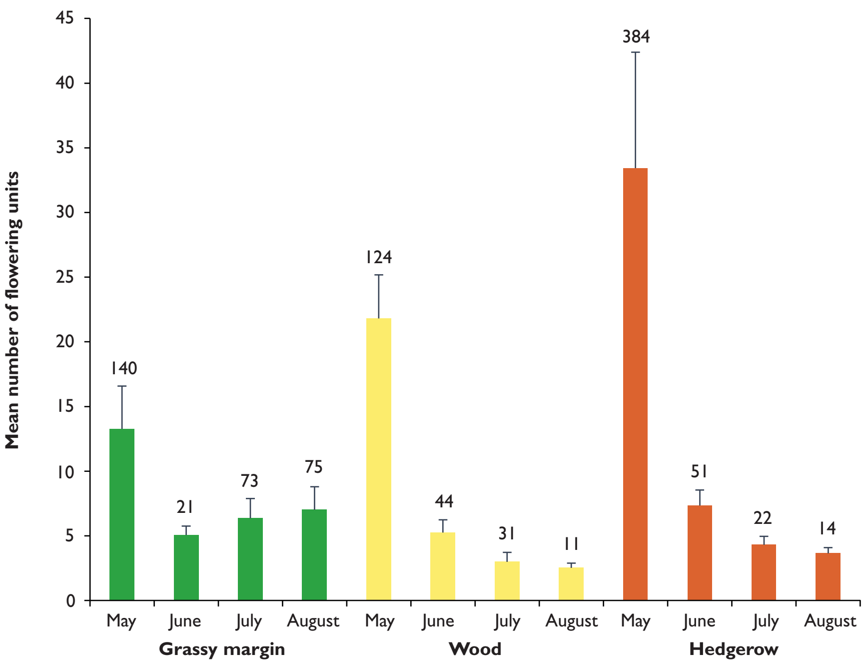
The lowland areas of Britain's farmland are interspersed with a network of woodland, hedgerows and grassy field edges. Such areas support a diverse array of invertebrates, and some of these provide useful services such as control of crop pests or pollination of crops and wild plants. Over the last two years, we have been measuring the contribution of these semi-natural habitats to some of these services as part of the EU-funded project QuESSA (Quantification of Ecological Services for Sustainable Agriculture). Our ultimate goal, alongside our 13 partners across Europe, is to provide guidelines and tools that will enable land managers and their advisors to better exploit these ecosystem services and so contribute to the development of sustainable farming systems.

The first step was to evaluate the potential resources that the main types of semi-natural habitats on farmland could provide, such as floral resources for pollinators and over-wintering cover for insects. In three habitats (woodland edge, hedgerows and grassy strips) on 12 farms, we conducted surveys of the vegetation species composition and structure at the border and inside each habitat using a combination of transect walks (coarse scale) and quadrats (fine scale). Transect walks were conducted to assess the abundance of pollinators, and water traps were also deployed to collect a wider range of beneficial insects in June, July and August.

The average plant diversity was relatively low in all three habitats – usually less than two species per quadrant – but on some farms was 3-5 times higher. Floral resources were most abundant in May for all three habitats, with only between a quarter and half of the amount in the following months (see Figure 1). Again, on some farms much higher levels were found, indicating that there is potential to improve these habitats.

Figure 1

Mean (± 1 se) and maximum number of flowering units per quadrant in each semi-natural habitat



ACKNOWLEDGEMENTS

We are most grateful to all the farms that participated. This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No 311879.

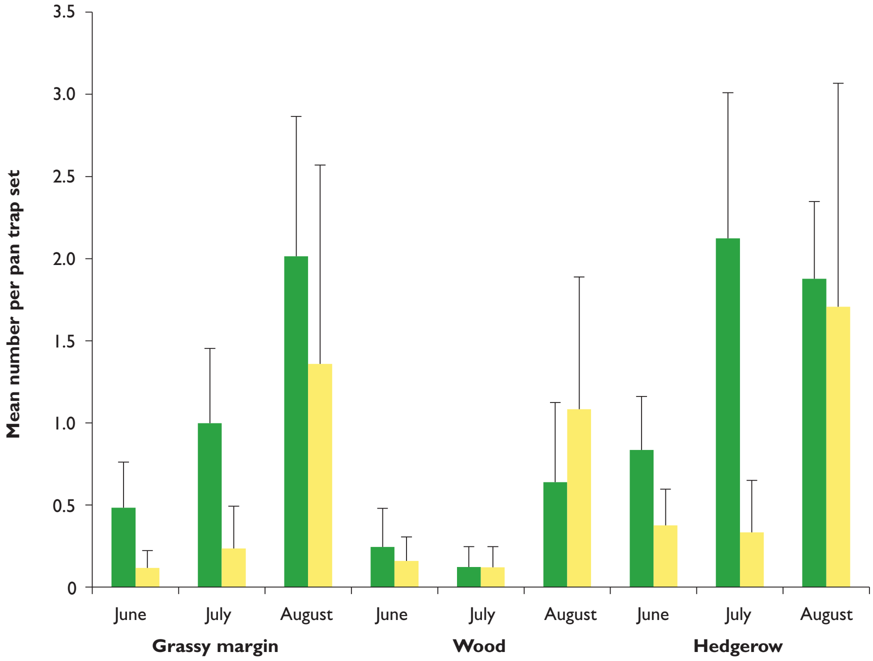


Figure 2

Mean (± 1 se) number of bumblebees and solitary bees in each semi-natural habitat

(Means are back-transformed following analysis)

Bumblebees

Solitary bees

A third more bumblebees were caught in hedgerows compared with grassy strips.
© Peter Thompson/GWCT

Transect walks revealed that hedgerows had more bumblebees than woodland. The water traps caught across all sampling occasions two to three times more bumblebees than solitary bees, and most of them were captured in August. A third more bumblebees were caught in hedgerows compared with grassy strips and at least a third less were caught in woodland (see Figure 2). Pest natural enemies were three or four times more numerous in August along hedgerows and grassy strips, but most abundant along woodland edges in June (see Figure 3).

The study showed that all three habitats can provide floral resources for pollinators and pest natural enemies. We suggest that a range of habitats are needed on farmland and that they should be managed to encourage a greater number of flowering species, especially as our surveys revealed that many contained relatively few species. We are now developing a scoring system from the 16 case studies across the whole project that will represent the potential contribution that semi-natural habitats can make towards these ecosystem services. This will then be used to inform simulation models that can predict the amounts, type and location of semi-natural habitat needed to improve levels of ecosystem services. For further information on QuESSA see **www.quessa.eu**

BACKGROUND

Semi-natural habitats such as woodland and hedgerows contain plants that provide resources for a diverse array of invertebrates. Some of these invertebrates assist with services such as pest control and crop pollination. To make better use of these of the services supported by these habitats and improve their management we first need to determine which plant and invertebrates are present and when within existing habitats.

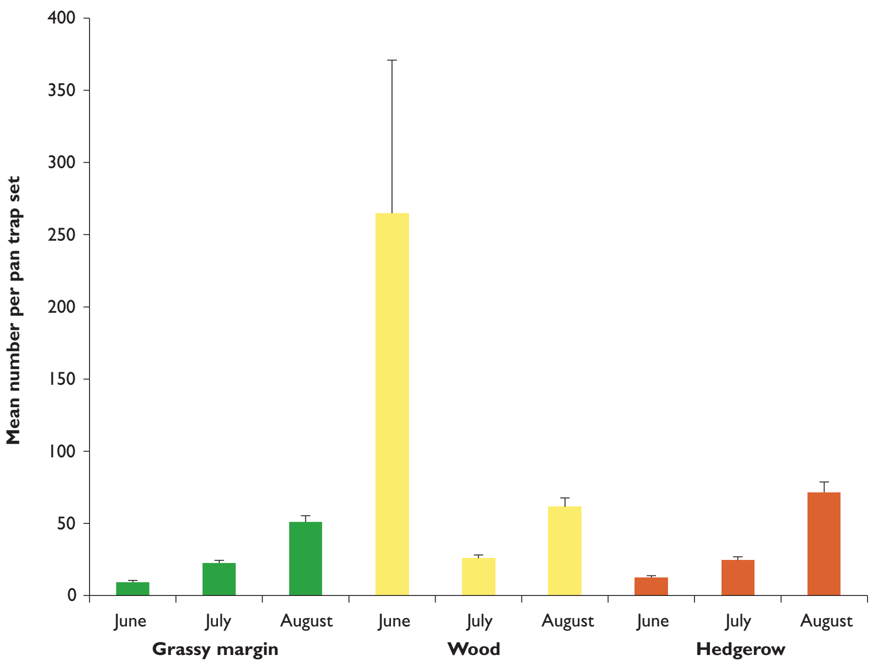


Figure 3

Mean (± 1 se) number of pest natural enemies in each semi-natural habitat

(Means are back-transformed following analyisis)

Allerton Project: game and songbirds

Songbirds such as blackbirds are benefiting from the current management system for reared pheasants. *© Laurie Campbell*

KEY FINDINGS

- Wild pheasants have not shown a positive response to our management for reared pheasants.
- Brown hare numbers increased, but so far remain lower than in the wild game management period.
- Overall songbird numbers have increased by 77% in the last five years.

Chris Stoate
John Szczur

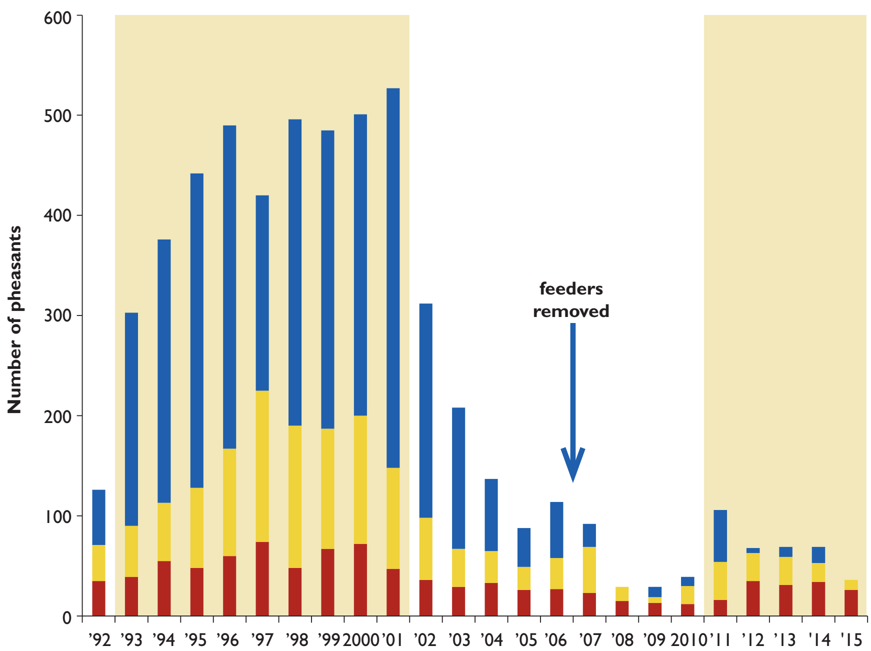
2015 was the fifth year of the current phase of game management at the Allerton Project; a released pheasant shoot. This period follows a baseline year in 1992, nine years of wild game management, and nine years in which game management was withdrawn. The reared pheasant shoot is intended to reflect the management that is adopted on pheasant shoots across the country, and provides an opportunity to understand both the economic challenges associated with such a shoot and the impacts on wildlife. To deliver the current reared pheasant shoot, we took on additional land and carried out predator control at a lower level than would be practised on a wild bird shoot, but at a higher level than is normal for reared shoots. Winter feeding was continued at a similar level to that undertaken during the wild game management phase. Habitat management has remained constant over the 23 years of the project, although there have inevitably been some changes to habitat over such a long period.

We have continued to monitor numbers of pheasants, partridges, brown hares and songbirds. This enables us to compare the effects of wild game management, no game management, and reared game management with predator control on both game and non-game species. The changes in numbers of game and wildlife are shown in the graphs. All species increased in number substantially following the 1992 baseline year in response to the wild game management system, and declined in the period in which predator control and winter feeding ceased. What is now interesting to see, is how different groups have responded to the management associated with a reared pheasant shoot with predator control.

Wild pheasant numbers have not increased above the level we recorded during the period without game management, and the number of young pheasants recorded each year has been very small (see Figure 1). Low breeding success may be a result of higher

Figure 1

Autumn wild pheasant numbers from 1992 to 2015



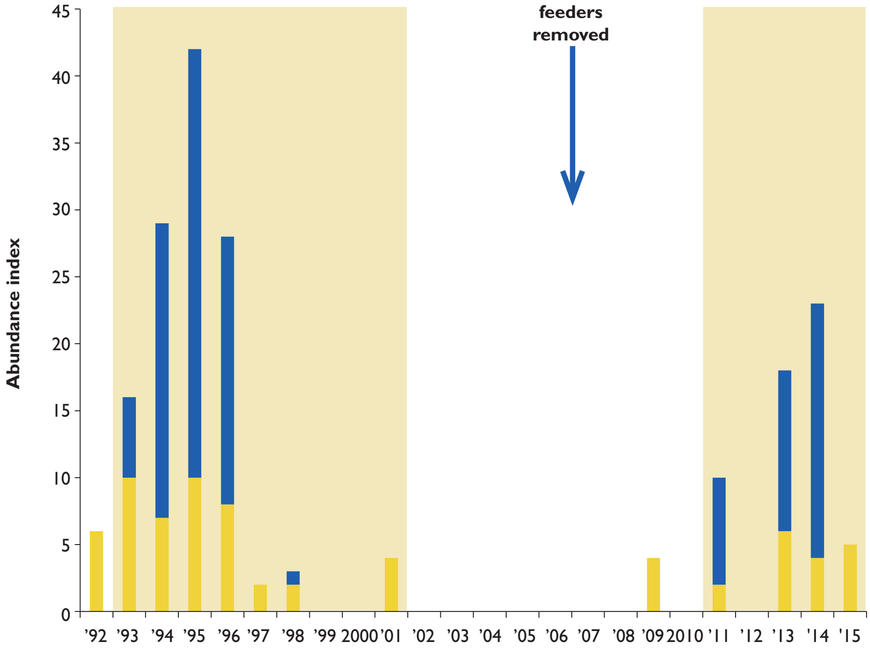


Figure 2

Autumn grey partridges

- Young
- Adults
- Keepered period

nest predation due to the lower level of predator control. It may also be because only reared hens with inherently low breeding success are recruited to the population. There is also some evidence to suggest that hens are susceptible to disease in the key spring period.

However, grey partridges were present only in very low numbers and then absent from 2002 and 2008. They bred successfully during the current phase, but no young were produced in 2015 (see Figure 2). Brown hares have increased in number three-fold over the same period while numbers at another local site, without game management, have changed little during the whole period of the project.

Songbird transects reveal an initial slight increase in numbers, that was checked by the prolonged wet weather in 2012. Numbers have subsequently increased and are now 77% above the 1992 baseline. The transect method represents all passerine species combined (excluding corvids) and conceals the variation between species. We gather data for individual species through territory mapping approximately every five years including 2015, and we have analysed maps for eight species (see Table 1). These reveal substantial increases in the five insect-eating species, song thrush for example, while seed-eaters (chaffinch, yellowhammer) remain close to the baseline.

Our monitoring suggests that management being carried out for reared pheasants, combined with additional predator control, is not benefiting the wild pheasants, although grey partridges seem to have responded in some years. The management appears to benefit brown hares and some songbirds, particularly the insect-eating ones.

Brown hare numbers have increased three-fold.
© Laurie Campbell

TABLE 1

Songbird breeding numbers, based on territory mapping

	1992	1998	2001	2006	2010	2015
Skylark	36	36	37	33	26	37
Dunnock	46	86	144	97	51	135
Blackbird	66	143	143	98	69	136
Song thrush	14	48	64	34	15	44
Whitethroat	25	44	45	48	59	58
Spotted flycatcher	8	11	14	6	1	10
Chaffinch	135	178	229	161	119	133
Yellowhammer	57	55	54	46	41	44

BACKGROUND

Game and songbird numbers have been monitored annually at the Allerton Project at Loddington since it began in 1992, providing an insight into how both have been influenced by changes of management over this period. In particular, they have provided valuable information on the effects of predator control and winter feeding.

The farming year at the Allerton Project

Earthworms are a key component of our soil management – underground livestock.
© Phil Jarvis/GWCT

KEY RESULTS

- Our focus is on improving soil health to increase yields.
- Reduced tillage has helped increase earthworm numbers.
- Low commodity prices have reduced farm profitability.
- Conventional and organic interactions were initiated at the Agricology launch.

Alastair Leake
Phil Jarvis

The improvement in crop yields seen in 2014 continued into the 2015 harvest, as weather conditions led to a fruitful, if showery, harvest. Winter beans and wheat provided some especially encouraging results, the former achieving a record yield of 5.5 tonnes per hectare (t/ha) for the farm and the latter well exceeding the long-term average of 8.15 t/ha. However, a plentiful global supply of arable produce has led to a steady decline in prices, with financial margins under pressure throughout the year. The farm has joined the recently established Welland Valley Crop Benchmark Group, sharing data and promoting best practice to help improve efficiency. The information gathered will help us plan for challenging times ahead.

We are continuing with fundamental changes to our arable farming system. These include a more diverse range of cover crops, rotational grass and spring crops. We have expanded our oil radish and oat cover crops to include phacelia, clover, beans and buckwheat. The rotational grass enters its third year and is set to enter arable cropping again in 2016. The use of spring oats continues to be another part of our strategy against the challenge of grass weeds and herbicide resistance.

In the United Nations 'International Year of Soils' it seems appropriate that some of our fields showed earthworm numbers up to 800 per square metre and a surprising 3.5% organic matter, which is above the level expected on a clay soil growing continuous arable crops. The importance of good soil structure is an integral part of our farming system, and it is noticeable how much better the soils with high numbers of earthworms are draining after heavy winter rainfall. In future we also aim to get our

BACKGROUND

The Allerton Project is based around an 333-hectare (800 acres) estate in Leicestershire. The estate was left to the GWCT by the late Lord and Lady Allerton in 1992 and the Project's objectives are to research ways in which highly productive agriculture and protection of the environment can be reconciled. The Project also has an educational and demonstration remit.

TABLE 1

Arable gross margins (£/hectare) at the Allerton Project 2010-2015

	2010	2011	2012	2013	2014	2015 (est)
Winter wheat	673	783	255	567	590	457
Winter oilseed rape	799	1,082	490	162	414	533
Spring beans	512	507	817	580	646*	396*
Winter oats	808	873	676	570	354	507

No single farm payment included
** winter oats*

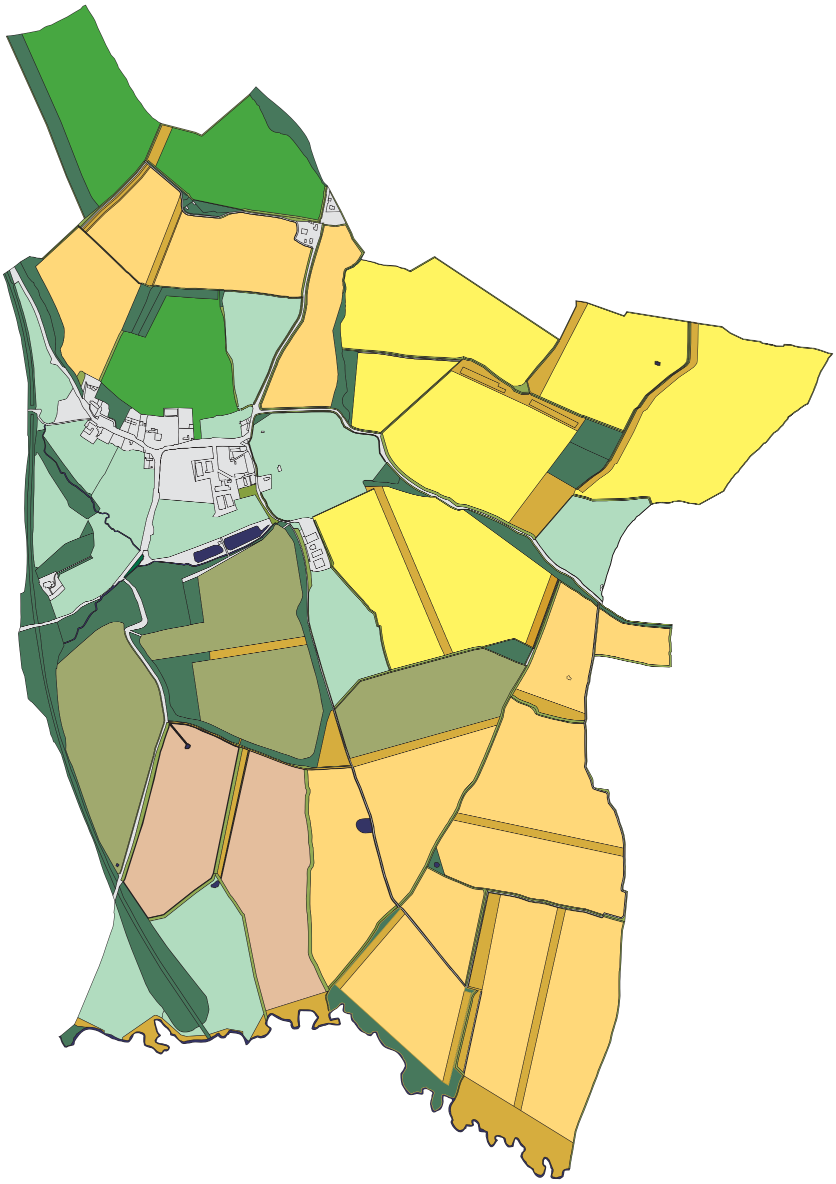


Figure 1

Allerton Project cropping 2014/15

In 2015 we added phacelia, clover and buckwheat to our oat and radish cover crops.
© Phil Jarvis/GWCT

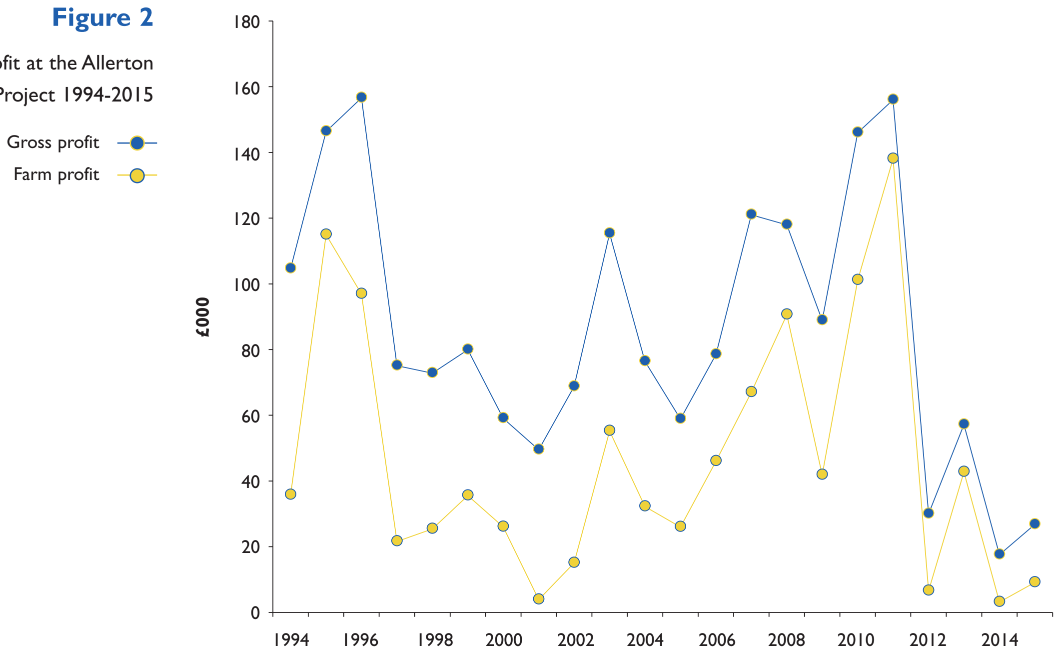
The Dale Eco-Drill now drills our cover crops, oil seed rape, wheat and oats. © Phil Jarvis/GWCT

soil flora and fauna functioning better to help recycle crop nutrients. The Dale Eco-Drill has become the main component of our reduced tillage system, and we have been looking at low disturbance sub-soilers, particularly the tine and packer design. Although compaction, black-grass and slugs are still challenging, last year's wet autumn has shown that properly functioning drains and ditches are essential on heavy clay soils.

There is growing interest within the UK arable sector to combine natural arable husbandry principles with precision technologies. Understanding the interactions of such systems will be key to their uptake and success. The launch of the 'Agricology' concept, a partnership led by the Allerton Project, the Daylesford Foundation and the Organic Research Centre will enable such an approach to gather momentum. Our role in lifting the theory from research papers to practical farmer demonstration will assist the essential knowledge transfer to farmers and growers.

Figure 2

Gross profit and farm profit at the Allerton Project 1994-2015



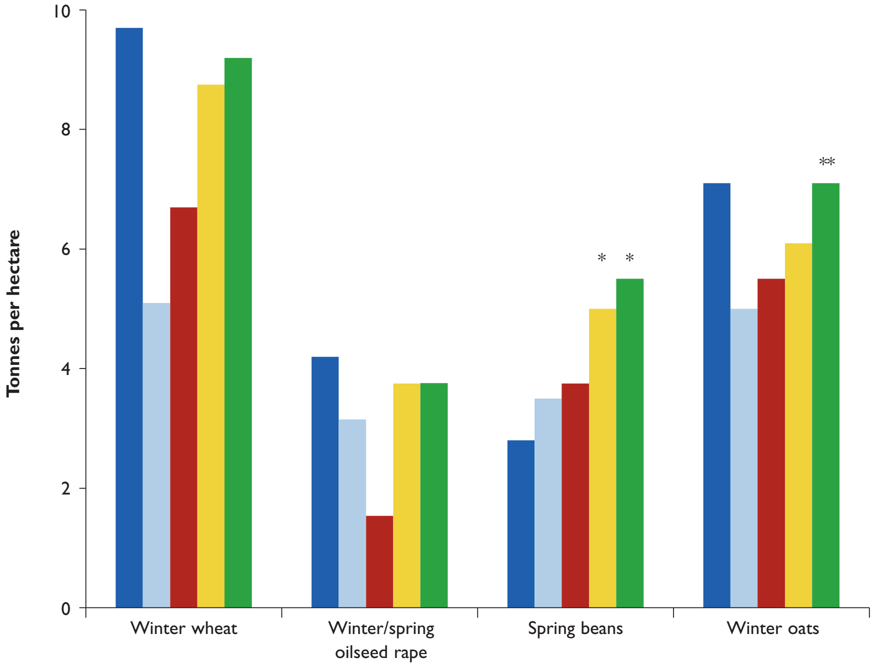


Figure 3

Crop yields at the Allerton Project in 2011-2015

Spring oilseed rape was sown in 2013

** winter beans **spring oats*

Once such concepts begin to be implemented by farmers, it is invaluable to share both the successes and shortcomings. Our work with the Kellogg's Origins farmers has concentrated on soil health, weed control strategies, farmland biodiversity and machinery. The importance of farmer-to-farmer engagement has led to many valuable discussions.

There is an ever-increasing requirement for Government, farmers' representatives and NGOs to work towards some common goals. The recent Common Agricultural Policy reforms have thrown up many challenges for the farming industry, and all involved in UK agriculture must adapt and learn to create less complicated win-wins for farming and the environment. The Allerton approach, combining profitable production, environmental responsibility and community cohesion, is one that might just provide a blueprint for the future.

TABLE 2

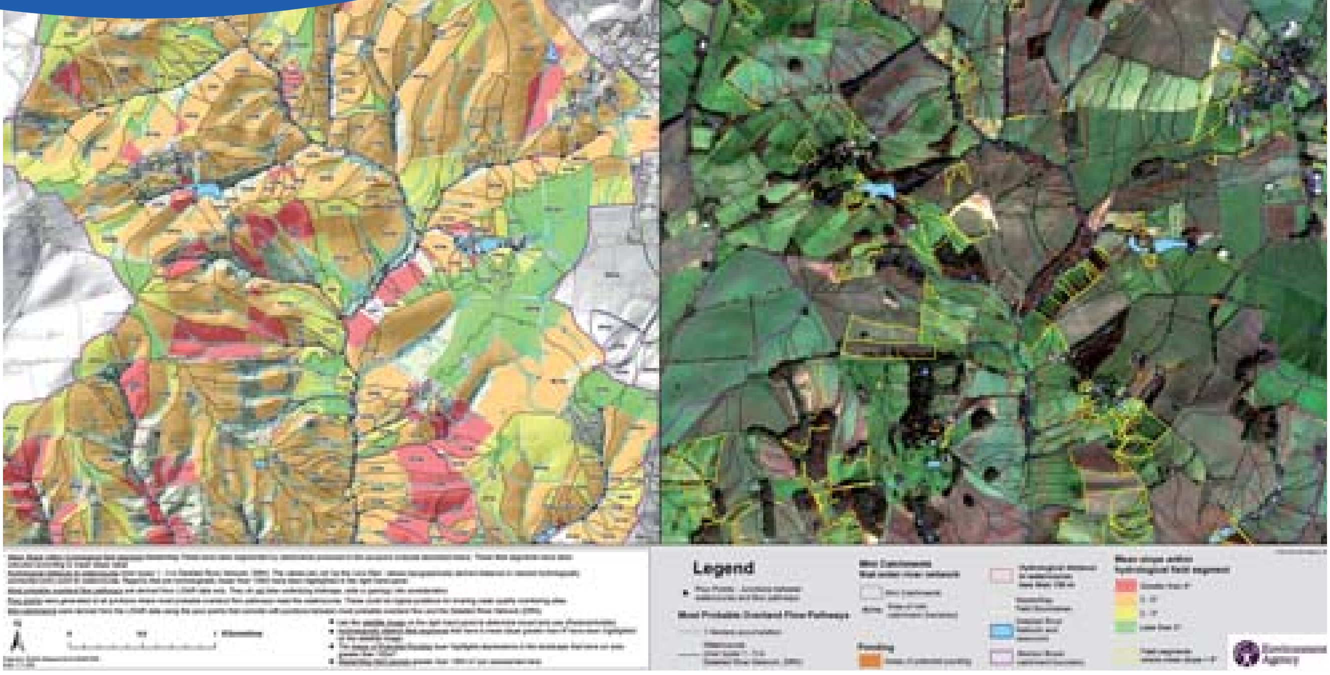
Farm conservation costs at the Allerton Project 2015 (£ total)

Higher Level Stewardship costs (including crop income forgone)	-26,753
Higher Level Stewardship income	29,516
Woodland costs	-11,596
Woodland income	3,395
Farm Shoot expenses	-6,460
Farm Shoot income	6,460
Grass strips	-500
Total profit forgone	
- conservation	**-5,938**
- research and education	**-11,696**
	-£17,634

Further information on how these costs are calculated is available from the Game & Wildlife Conservation Trust.

Harvesting oats. 2015 saw above average yields. © Phil Jarvis/GWCT

The Welland Valley Partnership



Remote survey data such as LIDAR and satellite images are used to identify areas of poorly performing crops, high run-off and erosion risk.

In 2010, Defra launched an initiative to support 10 river basin partnerships involving the statutory agencies, water companies, NGOs, and farming and angling interests in their efforts to meet EU Water Framework Directive targets. With a recently established Rivers Trust, an active catchment management research programme, strong farmer engagement, and developing collaboration with the Environment Agency, we were selected as one of the 10 pilots. Since then, the Welland Valley Partnership (WVP) has gone from strength to strength.

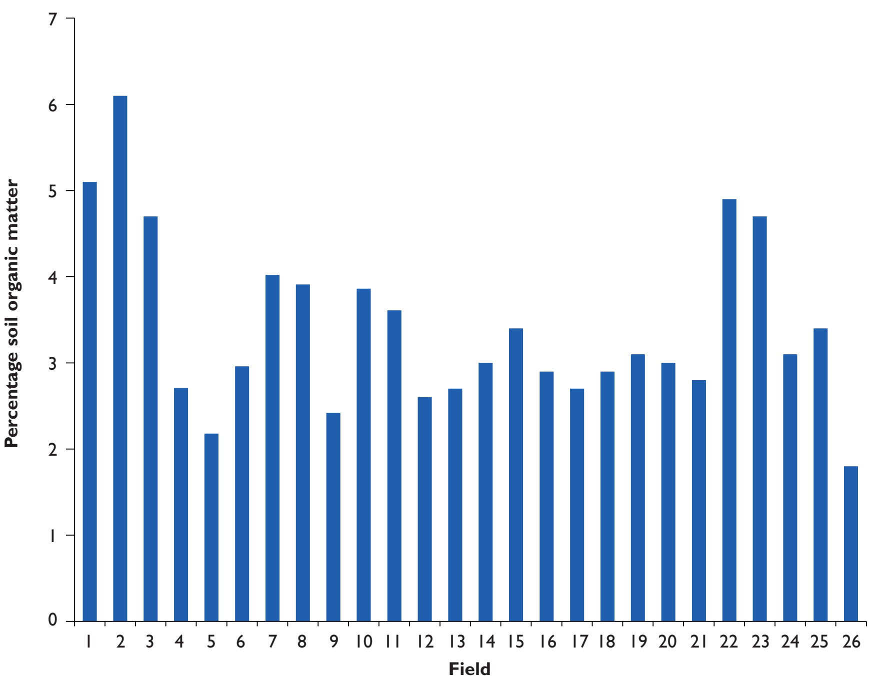
The WVP is chaired by the Welland Rivers Trust with support from the Environment Agency, and includes the NFU, CLA, Anglian Water, Angling Trust, local councils and the Internal Drainage Board, as well as the GWCT Allerton Project. While representing disparate interests, we have identified common objectives and are working together to achieve them.

BACKGROUND

The Allerton Project is located in the headwater of the river Welland and has been instrumental in setting up and co-ordinating the Welland Valley Partnership. Long-running soil and catchment management research at Loddington and in the Water Friendly Farming experiment is closely integrated with the activities of the partnership.

Figure 1

Percentage soil organic matter for individual fields across the upper Welland river basin



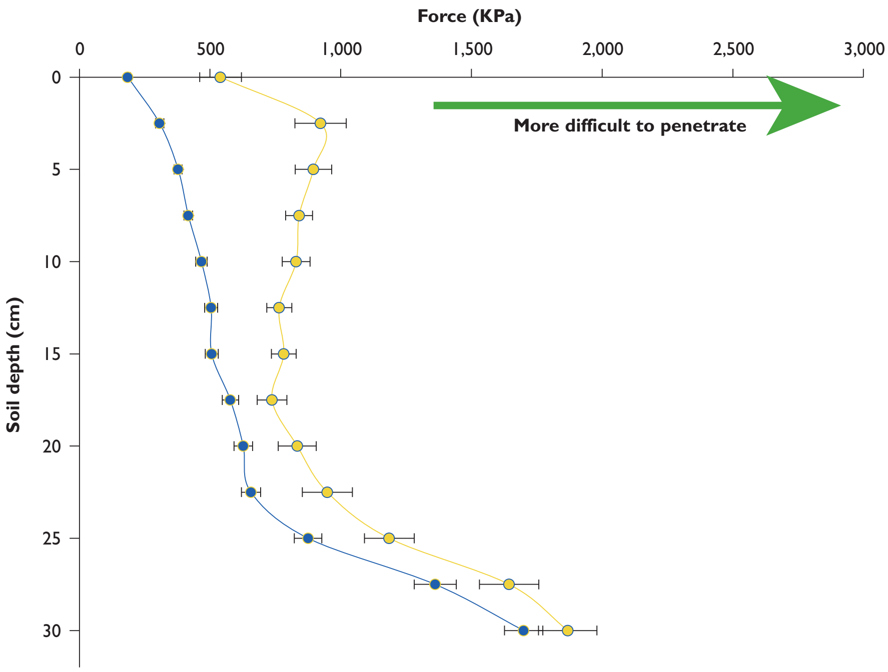


Figure 2

Soil compaction data can be used to inform remediation that will improve crop performance and reduce erosion and impacts on water. In this field, a compacted 'plough pan' is clearly visible at 25-30cm

Over the years, we have provided advice to farmers and delivered workshops and a range of activities associated with farmer knowledge exchange in the river basin, especially in the upper catchment where Loddington and our Water Friendly Farming experiment are located (see *Review of 2014*).

We can use research results from the Water Friendly Farming experiment, and from our research into mitigation methods at the Allerton Project, to inform discussions with farmers. For example, we know that annual soil loss to water in our study area is about 0.5 tonnes per hectare, and we have detailed data on the presence of key pesticides in our study streams. We know that reducing tillage frequency and intensity, improving soil organic matter and ecology, and reducing tramline compaction can all contribute to better-functioning soils in terms of both crop performance and water quality.

This is far from a one-way process in which research results are fed in one direction to the farmers. Farmers help to contribute to the development of our plans for advice and management, and to our research. One mechanism for this is the Welland Arable Business Group, which is facilitated by the Agriculture and Horticulture Development Board and enables farmers to benchmark the economic performance of their individual businesses against the average, and to explore the underlying differences with a view to improvement.

Members have become increasingly aware of the relevance of soil organic matter to soil health and crop performance, and we have been able to gather data from Welland farms so that we can benchmark organic matter as well as farm economics. As with the economic data, organic matter data can be used to inform decisions on farm to improve performance. Most fields are below the 5% value regarded as being optimal (see Figure 1). Higher soil organic matter improves water quality as well as cropping, for example through improved infiltration and water retention. It also has implications for climate change mitigation through reduced diesel use and increased carbon storage. This provides a clear example of multiple benefits arising from a single management approach. Similarly, data collected on soil compaction from fields in the upper Welland can be used to target remedial action that improves crop performance and water quality (see Figure 2).

In one tributary, we are testing the use of satellite data and images to work with farmers to identify areas of poorly performing crops and high run-off and erosion risk (see main picture). The recent designation of the Stonton catchment as a Catchment Sensitive Farming (CSF) area enables us to work with CSF locally and nationally to apply this approach. It has also enabled us to take on our own catchment officer so that we can step up our exchange of knowledge between farmers and researchers.

KEY FINDINGS

- The Welland Valley Partnership provides an excellent example of a range of organisations working together to meet common objectives.
- Our research results are used to inform management on farms.
- Farmers are actively involved in research and in benchmarking soil properties, as well as economic performance.

Chris Stoate

Soil health influences both crop yields and water quality. © Chris Stoate/GWCT

Approaches to restoring bird abundance

The abundance of priority bird species on both farms was positively related to the amount of habitats providing summer food. © RSPB

KEY RESULTS

- At the GWCT's Allerton Project Farm and the RSPB's Hope Farm, both managed as demonstration sites, bird abundance increased much faster than within the surrounding regions.
- At both farms, the abundance of priority bird species was positively related to the amount of habitats providing summer food.
- Supplementary feeding during winter was associated with fewer breeding birds, but an equivalent interpretation was more breeding birds with more hedgerow management, because both changed in opposite directions at identical times.
- The abundance of open-cup nesting species at the Allerton Project Farm was inversely related to predator abundance, as measured by corvid density.
- Predator management was necessary to maintain numbers of open-cup nesters at the Allerton Project Farm, although the same was not true at Hope Farm where predator densities were much lower.

Nicholas Aebischer
Chris Stoate
Will Peach (RSPB)

Following the widespread declines of farmland birds since the 1970s, many species were given priority status in 1995 under the UK Biodiversity Action Plan (BAP). Research has found that the main factors causing decline were a lack in one or more of the following: nesting habitat, chick food and winter habitat. The GWCT and the RSPB have both sought to show policymakers and land managers that, with the right habitats deployed together at sufficient scale, it is possible to provide the critical resources that farmland birds need to survive, breed successfully and rebuild their numbers. They have done so through practical demonstrations on the ground, the GWCT since 1992 at the Allerton Project Farm (see pages 52-57), and the RSPB since 2000 at Hope Farm.

The Allerton Project Farm was a bequest from Lord and Lady Allerton in 1992. Covering 292 hectares (ha), it comprises 73% arable, 14% pasture and 8% woodland, in a landscape made up of 46% arable, 40% grassland and 11% woodland. In 1992, farm management was left unchanged to allow baseline wildlife monitoring. From 1993, it changed to accommodate the ecological requirements of wild gamebirds, using set-aside and agri-environment options for habitat creation (mainly grass margins, beetle banks, conservation headlands and wild bird cover). The amount of land managed in this way ranged from around 9% until 2002, to over 12% thereafter (see Figure 1). From 1993 to 2001 inclusive, a full-time gamekeeper controlled common avian and mammalian nest predators and provided supplementary grain in winter. Predator control stopped after 2001, supplementary grain provision ceased in spring 2005, while habitat management continued throughout. Breeding bird abundance was monitored annually by counting birds four times between April and June along 11.5 kilometres (km) of transects, as well as by nest counts (corvids) and March game counts (pheasants and partridges). The annual density of carrion crow plus magpie pairs served as an index of generalist predator levels. After an initial drop, the index remained at zero throughout the keepered period, then increased steadily thereafter to reach double the 1992 level in 2010 (see Figure 1a).

Hope Farm, purchased by the RSPB in 1999, totals 181ha comprising 93% arable, 3% permanent pasture and <1% woodland. The surrounding landscape is made up of 78% arable, 15% grassland and 3% woodland. The original three-year rotation was maintained for baseline wildlife monitoring in 2000 and 2001, then spring cropping and wildlife-friendly measures (mainly floristic margins, pollen-and-nectar strips, skylark plots, unharvested cereals, wild bird cover) were introduced over the next three years and gradually expanded using set-aside and agri-environment options to reach up to 9% of farm area

Woodland management has been carried out at the Allerton Project which has provided habitat for birds. © GWCT

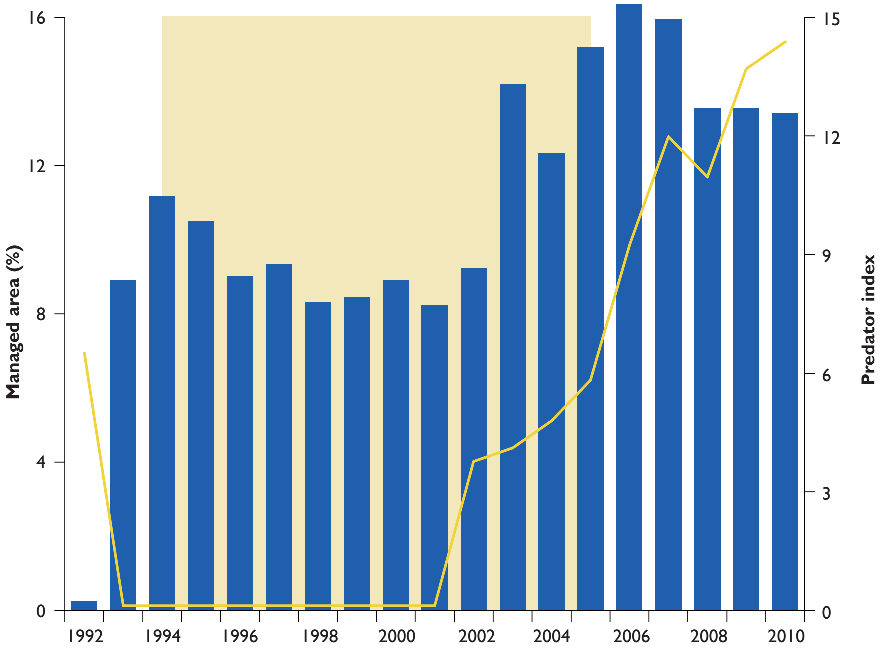


Figure 1a

Annual amount of habitats managed for birds as a percentage of farm area (blue bars) and index of predator abundance (yellow line) at the Allerton Project Farm (1992-2010)

Supplementary grain provided over winter

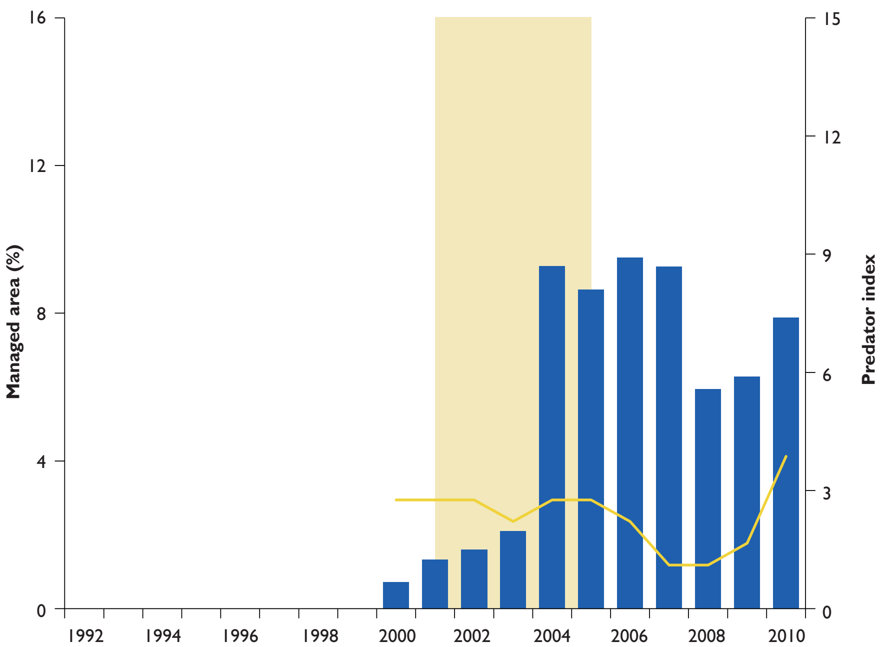


Figure 1b

Annual amount of habitats managed for birds as a percentage of farm area (blue bars) and index of predator abundance (yellow line) at Hope Farm (2000-2010)

Supplementary grain provided over winter

(see Figure 1b). This was similar to the first 10 years at the Allerton Project Farm, and the ca 5% difference in subsequent years was almost entirely due to an expansion in the amount of grass margins at the Allerton Project. No predator control took place at Hope Farm, and supplementary winter grain was provided only until spring 2005. Breeding bird abundance was monitored annually by territory mapping, with 10-12 visits between April and July. The predator index (carrion crow plus magpie pair density) varied relatively little (see Figure 1). It lay above the levels recorded at the Allerton Project Farm during the keepered phase and below those recorded during the non-keepered phase.

We derived a combined index of abundance for farmland birds (19 species in the Government's Farmland Bird Index), declining birds (based on 19 Biodiversity Action Plan (BAP) species), and for birds whose nests were potentially vulnerable to nest predation (21 open-cup nesting species, mainly thrushes, warblers and finches). Each index was calculated as the geometric mean of its constituent species counts standardised to a starting value of 1 at each site. Breeding Bird Survey (BBS) data from the British Trust for Ornithology provided background regional trends in bird abundance for 1994-2010 (East Midlands region for the Allerton Project Farm, East of England region for Hope Farm), which we processed in the same way as the farm counts.

BACKGROUND

The GWCT and RSPB each manage a demonstration farm, the Allerton Project Farm at Loddington, Leicestershire, since 1992 and Hope Farm in Cambridgeshire since 2000. The aim is to show policymakers and land managers that economic farming and biodiversity are not mutually exclusive, and in particular that we know enough about the ecological requirements of declining farmland birds to restore their numbers through targeted management. Through the success of these farms, both organisations seek to influence agricultural policy and practice to improve farmland bird conservation. We describe the changes in bird abundance that have taken place over time at the two farms in relation to background trends and on-site management.

Figure 2a

Annual indices of abundance (solid lines) for Farmland Bird Index species at the Allerton Project Farm and Hope Farm, as well as for their respective regions, the East Midlands and the East of England. Indices of abundance are relative to the start year, which has a value of 1

Allerton Project Farm
East Midlands

Hope Farm
East of England

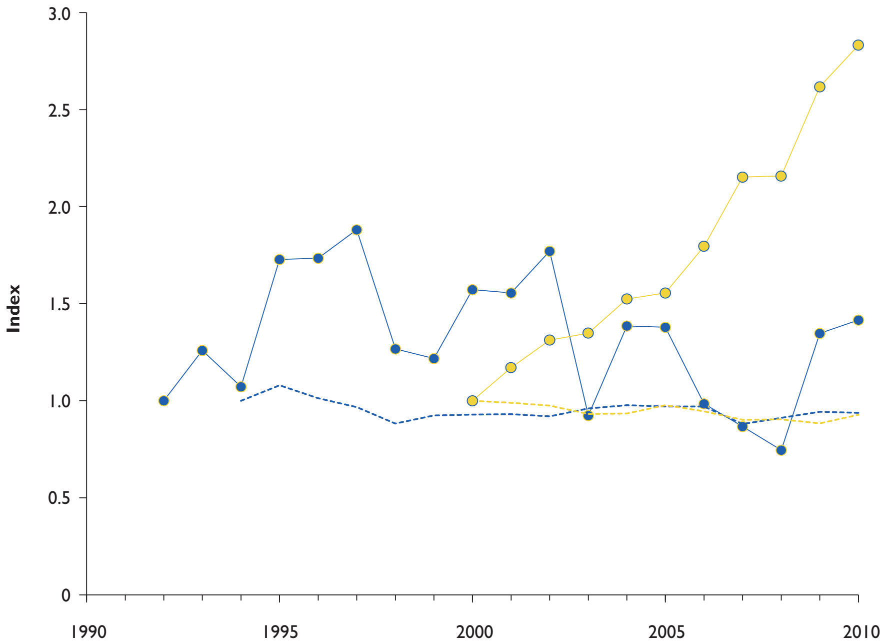
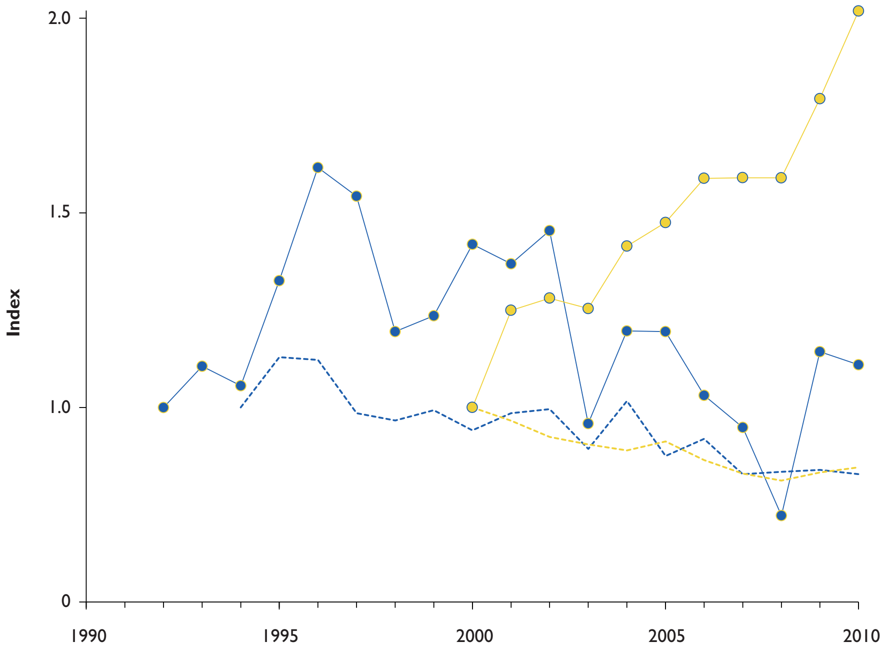


Figure 2b

Annual indices of abundance (solid lines) for Biodiversity Action Plan species at the Allerton Project Farm and Hope Farm, as well as for their respective regions, the East Midlands and the East of England. Indices of abundance are relative to the start year, which has a value of 1

Allerton Project Farm
East Midlands

Hope Farm
East of England



At Hope Farm, 3.2 hectares of floristic margins have been provided for wildlife. © RSPB

At the Allerton Project, Farmland Bird Index (FBI), BAP and open-cup nesting species all increased rapidly over the first five years of the study, roughly stabilised for the remainder of the predator-control period, then subsequently declined to levels close to their starting level (see Figure 2a, b, c). At the peak, species abundance had increased by 60% to 150% depending on the group. At Hope Farm, the pattern for all groups was of a steady increase, such that by 2010 numbers had more than doubled (see Figure 2a, b, c). At both sites, the changes contrasted with the background regional patterns of a long-term decline of farmland and BAP species, and approximate stability for open-cup nesters (see Figure 2a, b, c). The maximum annual rate of increase over five years, which measures the potential for recovery under suitable conditions, was 13% and 12% for FBI species at the Allerton Project Farm and Hope Farm respectively, 11% and 7% for BAP species, and 19% and 11% for open-cup nesters (see Figure 3). In all cases these values far outstripped those calculated for the matching regions.

For both sites, we calculated the proportions of farm area comprising nesting cover, summer food and winter cover each year, and related these, together with the predator index and availability of supplementary food, to the abundance of BAP species and open-cup nesters in an analysis that took into account density dependence and serial

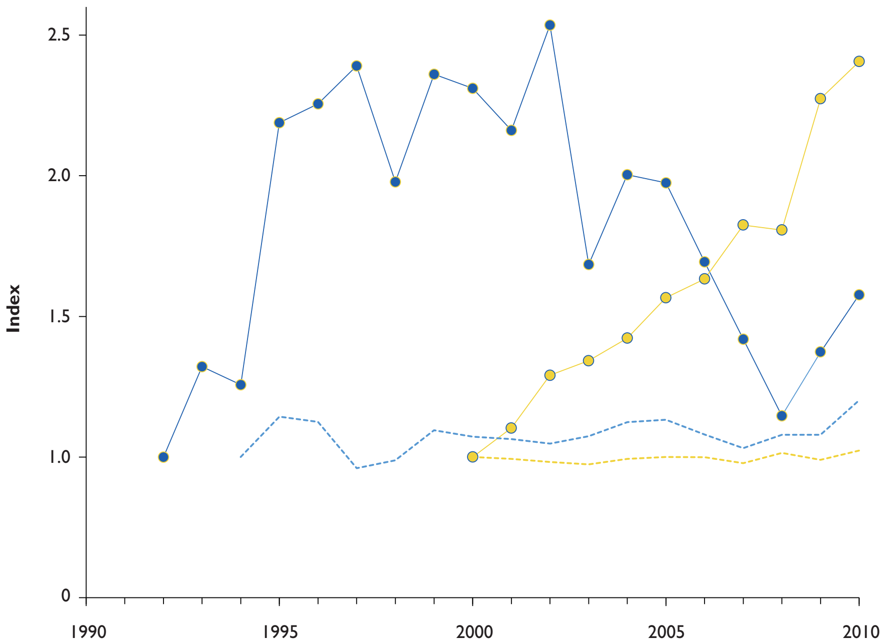


Figure 2c

Annual indices of abundance (solid lines) for open-cup nesting species at the Allerton Project Farm and Hope Farm, as well as for their respective regions, the East Midlands and the East of England. Indices of abundance are relative to the start year, which has a value of 1

- Allerton Project Farm
- East Midlands
- Hope Farm
- East of England

correlation. For both bird groups, abundance was positively related to the provision of summer food habitats. It was negatively related to the use of supplementary winter food, but an equivalent interpretation was of a positive relationship with amount of hedgerow, because by chance hedgerow management increased when supplementary feeding ceased. The abundance of open-cup nesters was inversely related to the predator index, a finding that was largely driven by changes at the Allerton Project.

At both farms, the provision of safe nesting sites and access to food has allowed farmland bird numbers to double or even treble in just five to 10 years, in stark contrast to the continuing declines seen in surrounding regions. This suggests that a greater roll-out of wildlife-friendly farming measures should lead to a recovery of farmland birds in the wider countryside. Predators occurred at a high density at the Allerton Project Farm, and the recovery of open-cup nesters required predator management as well as habitat improvement to boost numbers. At Hope Farm, where predator density was low, bird recovery was achieved solely by habitat management. Predator density was probably a function of landscape character: wooded with mixed farmland in Leicestershire; open and mainly arable in Cambridgeshire. Further research is needed to understand how typical the Allerton Project Farm and Hope Farm situations are compared to the rest of the country.

The abundance of open-cup nesters at the Allerton Project Farm, such as song thrushes, was inversely related to the predator index. © Laurie Campbell

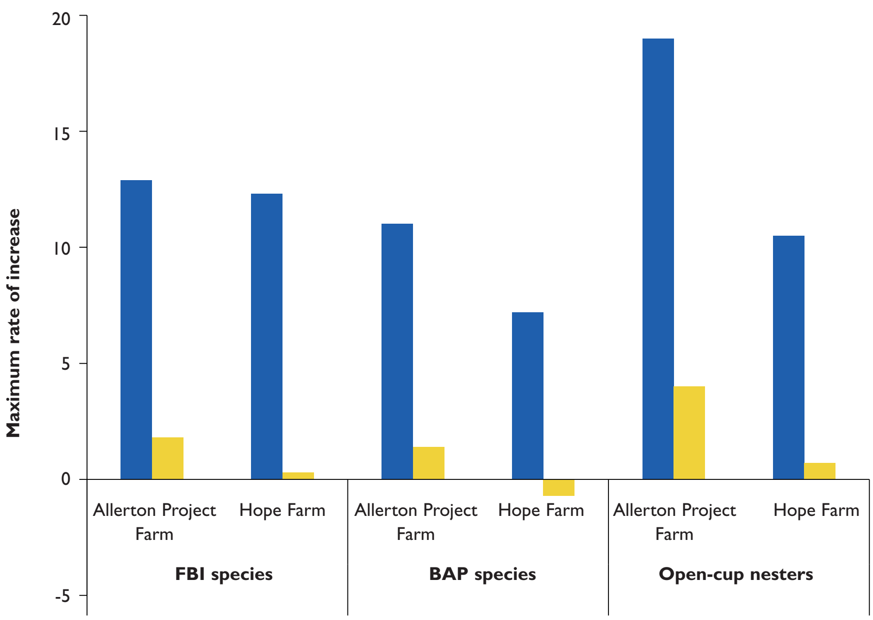


Figure 3

Maximum annual rate of increase over five years for Farmland Bird Index (FBI), Biodiversity Action Plan (BAP) and open-cup nesting species at the Allerton Project Farm and Hope Farm and their respective regions

- Farm data
- Regional Breeding Bird Survey

Farewell to the Fenn trap

The Fenn trap, like the Land Rover, has served for half a century, but has been left behind by rising standards. © Mike Short/GWCT

KEY FINDINGS

- Because of poor humaneness, use of Fenn-type traps to catch stoats will presently become unlawful.
- The future value of Fenn traps as a 'catch-all' pest trap is therefore also doubtful.
- Formal humaneness testing of alternative traps by Defra is in progress, but subject to tight budget constraints.
- Consequently, the timescale of changes in legislation is uncertain.
- Avoid buying large numbers of traps until future provisions are made clear.
- Watch the GWCT website for updates.

Jonathan Reynolds

Fur trade war

The Agreement on International Humane Trapping Standards (AIHTS) is a deal worked out between the EU and other trading blocs. In the 1980s, anti-fur-trade activists brought about a resolution in the European Parliament that the EU should ban the import of furs from countries where wild animals were caught using 'inhumane' traps. Leg-hold traps were a particular focus. There was a kick-back, however: targeted countries pointed out that traps were used for pest control in the EU; that leg-hold traps were technically lawful in most EU countries; and that it was unclear where the distinction lay between humane and inhumane traps. Negotiation ensued, and the compromise that emerged was an agreement that trade could continue, but that signatory parties (EU, Canada, Russia; a very similar agreement exists with the USA) would allow only traps that met a defined standard for humaneness. As members of the EU, the UK and all other EU states are committed to this agreement.

Britain leads on decency

In 1822, the United Kingdom led the world by legislating to prevent acts of cruelty to domesticated animals. Successive acts of parliament, aiming to further secure animal welfare, have added neglect, scientific experiments on animals, pets, performing animals and wildlife to the issues addressed. This has generally been seen as a civilising movement: Britain has built a reputation for decent treatment of animals.

Animal welfare was first extended to wildlife management in the UK through the Pests Act 1954, which sought to improve the effectiveness of pest control at a national level, but also to regularise the methods allowed. It set a timetable for prohibition of gin traps, which had received a lot of criticism for inhumaneness, particularly when used as leg-hold traps to catch larger mammals and birds. This was another 'first' for Britain.

The Pests Act allowed four years for gin traps to be phased out. So from 1958 (1971 in Scotland), the only spring traps that could be used were those approved by the Ministry of Agriculture as suitable for their purpose. It was left to the market to find a replacement. Within three years, Arthur Fenn had created his Mark 1 and Mark 2 Fenn traps, and obtained approval for them.

Clear criteria for the AIHTS standard

There were no official criteria for ministerial approval of traps, and through subsequent decades trap models were approved on inconsistent grounds: some because they were improvements on earlier versions (eg. the Fenn Mk 1 was succeeded by Mk 2, 3 and 4); others because they were 'clones' of traps already approved (eg. Springer and Solway traps); and others just because they were no less powerful than those already approved.

The AIHTS standard defines clear criteria for both kill traps and live traps. For kill traps to be allowed, at least 80% of captured animals must be rendered dead or irreversibly unconscious within a stated time interval. The target time ranges from 45 seconds to three minutes, depending on species, and reflecting what was considered possible. Canada has now certified 193 different trap models as meeting these requirements, representing about 40% of those tested. Quite deliberately, the AIHTS standard reflects the best that is currently possible, while cutting away the poor performers.

Inspection intervals are often considered by outsiders to be especially important in trapping. But unless traps are inspected every two minutes, shortening inspection intervals can achieve nothing that is comparable with this humaneness standard. Traps that meet agreed humaneness standards could therefore help practitioners to get on with their job with less controversy. But the primary requirement is effective wildlife management, so traps must be effective and affordable, as well as humane, selective and safe. Achieving all these qualities is a tough challenge.

Scope and consequences of AIHTS implementation in UK

The scope of the AIHTS is limited to a selection of mammal species from which wild-caught fur is commonly traded. Of those occurring in the UK, some (badger, beaver, otter, pine marten) may only be caught under special licence. Other species commonly trapped here (fox, mink) are not included in AIHTS, apparently because the fur trade deals almost exclusively in farmed animals with non-wild colouration. The stoat is the only one of the listed species that occurs in the UK and is caught here in appreciable numbers without special licence.

Literal implementation of the AIHTS will clearly create a nonsensical situation for all signatory countries, because we will have a humaneness standard for some mammal species but not for others. It will prohibit the capture of stoats in some trap types, but not the capture of weasels, squirrels or mink in the same traps, simply because humaneness has been tested for stoats but not for the others. In the UK, no currently approved trap has been tested to AIHTS standard for all the species for which it is lawful. Many trap models commonly used in various walks of life for other species will remain approved, even though they have never undergone any humaneness testing. Sweden tried applying the AIHTS standard to traps for commensal rodents and had to fail 28% of mouse traps and 42% of rat traps.

KNOWING THE LAW

Not personally running the traps? You could still be prosecuted. A reminder: the Wildlife & Countryside Act 1981 has been amended throughout the UK to make it an offence in itself to "knowingly cause or permit" trap-related offences. Thus, if a trap user is convicted of an unlawful act, the relevant employer or landowner could also be charged with having caused or allowed it.

In Scotland, the Wildlife and Natural Environment Act 2011 adds a more explicit 'vicarious liability', which differs in that both parties could be prosecuted independently. It is not necessary to convict the trap user in order to prosecute the employer or landowner who caused or permitted an unlawful act.

So it is already important for any landowner, agent or shoot manager – as well as gamekeepers and pest controllers – to keep abreast of changes in the law, and to ensure that traps used on their land always conform to current Defra approvals. The AIHTS will therefore affect you too. Stay informed – watch our website for updates.

Imminent changes to UK laws on trapping stoats are the result of the EU attempting to interfere with furbearer trapping in Canada, Russia and the USA by threatening trade sanctions in the 1980s.
© David Iliff. License: CC-BY-SA 3.0

It isn't clear yet which traps will be approved for stoats after testing is complete. New traps may emerge, but initially there was only a short list of possible contenders. Clockwise from left: WCS Tube Trap, Victor EasySet Rat Trap, DOC trap (in tunnel), BMI Magnum 116, and (centre) Koro Small Rodent Trap. © Mike Short/GWCT

Defra may have wished to approach the issue more logically, and it did decide in 2011 that all future trap approvals, for all species, would be based on testing to the AIHTS standard. But in the 18 years since the AIHTS was agreed, the budget has never been sufficient for comprehensive re-testing of traps already approved. Given current austerity measures, the budget for such work is effectively zero, and Defra has indicated that, in future, testing of new traps must be paid for by the 'industry'. So it will be hard enough to resolve just the stoat issue.

Ticking clock

Ratification of AIHTS by its signatory parties was completed in 2008. That set a clock ticking. A total of eight years was allowed for implementation: five years for trap testing to take place, three for trap users to replace failed models. Although Canada took the AIHTS very seriously from the start, little has happened within the EU. For four years, EU member states expected a directive. A draft directive was prepared by the European Commission in 2004 but was rejected by the European Parliament, mostly on the grounds that it didn't go far enough. In 2012 the European Commission announced abruptly that a directive was unnecessary, and that it was up to individual states to honour the agreement through their own domestic legislation. That still left four of the eight years, with implementation to be complete by July 2016.

The UK did relatively little until March 2015, when Defra held a meeting with stakeholders to outline how it planned to make the UK compliant by July 2016. That deadline had to be honoured, for fear of infraction proceedings by the EU. But the first steps had to be consultation (which still hasn't happened at the time of going to press), and trap testing to clarify which traps can be approved for stoats after implementation. Only then could Defra commit to its chosen policy, after which it would be necessary to make small changes to secondary legislation (Wildlife & Countryside Act Schedule 6, General Licences, Spring Traps Approval Orders). These changes will need to be replicated in Scotland, Wales and Northern Ireland.

The overall effect of these changes would be to make it unlawful to catch stoats in traps that had failed the AIHTS humaneness standard. From what is already known, Fenn traps and their clones are very unlikely to pass, and neither Defra nor anyone else intends to incur the cost of further testing. Approval to catch stoats in Magnum traps will also be withdrawn as a result of recent testing.

This will clearly prevent the use of Fenns and Magnums as 'universal' traps to target a range of small mammalian pest species. It was precisely in anticipation of this crisis that the GWCT submitted the New Zealand DOC trap series for approval in 2006. Those traps had been created in New Zealand for exactly the same reason. Regrettably, market forces have made DOC traps an expensive import, and a special tunnel design is required too. There are no other obvious successors that can take the place of the Fenn trap without some adaptation of working practices.

There are major decisions ahead for those who run tunnel traps in significant quantities. As we go to press, it remains unclear which traps will ultimately be approved in the UK to catch stoats. Once we do know, trap users for whom stoats are a priority will need time to become familiar with new models, make their decision about which to buy, and place an order. The traps will have to be made in large quantities, imported in many cases, distributed, and deployed in the field, while making any changes to tunnel design that are required by the new traps.

The July 2016 deadline is now impossible to meet, but equally there is a real urgency to find new trap types and develop new ways of working with what is available. For the moment, the Trust's advice is not to buy Fenn-type traps if you can use other types, and not to buy large quantities of any trap until the options become clear. Watch **www.gwct.org.uk/aihts** for updates.

BACKGROUND

Since the 1950s, the Fenn trap has been a mainstay of traditional gamekeeping in the UK. Now, as a result of a commitment made by the EU, it is probable that the trap will soon be banned, at least for the capture of stoats. It's all about improving standards of trap humaneness around the world. But don't look for too much logic.

The stoat as 'by-catch'. Fenn-type traps will apparently remain lawful to catch grey squirrels, though we have doubts about their humaneness for the purpose. Squirrels do not fall within the remit of AIHTS, hence Defra has no obligation or budget to re-test these traps for squirrels. The risk of catching a stoat when trapping squirrels can be reduced by using an appropriate bait (maize in this case) but cannot be completely avoided. © Mike Short/GWCT

River Frome salmon population

We have been able to install new state of the art PIT tag antennae on the river to replace the ageing system that has been in place since 2002.
© Rasmus Lauridsen/GWCT

KEY FINDINGS

- The low number of adults returning in 2013 resulted in a poor 2015 smolt run.
- The new PIT-tag systems are operating at a high level of efficiency and they provide us with new valuable data on in-river transition times and loss rates of smolts.
- 2015 marked the start of a large scale juvenile trout tagging programme with exciting prospects of collecting population and life history data on this enigmatic species.

Rasmus Lauridsen

The first in-river array of PIT tag antennae at East Stoke was installed in 2002. The primary aim was to establish a robust method for assessing the output of salmon smolts from the River Frome. This array has provided us with one of the most accurate methods of estimating smolt output in Europe. However, after 13 years in the river, the array is now wearing out. With financial support from GWCT sponsors and core funds, as well as from our recent EU project, MorFish, we have been able to replace the old system with a new, state-of-the-art one.

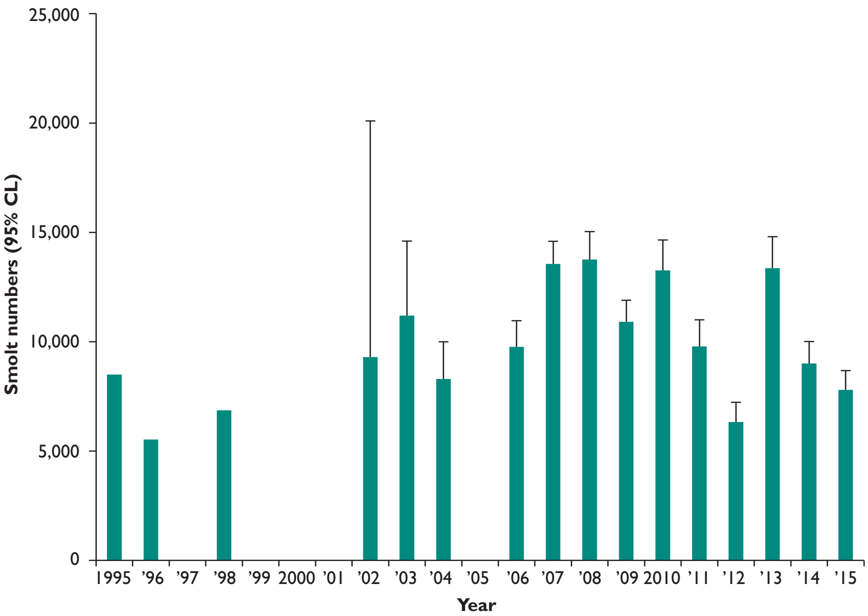
Not only were we able to replace the old system but we have also installed full river coverage arrays at two additional sites at Bindon Mill and Nine Hatches, three kilometres (km) and 21km upstream of East Stoke respectively. A total of 22 antennae were installed during 2014. After installing the PIT tag antennae there were a number of teething issues, primarily because these systems are very sensitive to electronic noise in their environment and the conditions at each location are unique. At the end of the winter these issues had been ironed out, and we are delighted to report that during the 2015 smolt run the new system at East Stoke was operating at an overall efficiency of more than 92%, which is very impressive for a full river coverage array.

We had a poor smolt run in 2015, with just under 7,000 smolts leaving the river (see Figure 1). This was likely the result of a very low number of adult salmon returning to the river in 2013 (see Figure 2), giving rise to only 70,000 parr in the whole catchment compared with a 10-year average of 95,000. Like 2013 the adult count for 2014 was very low resulting in the Frome falling considerably below its conservation limit in two consecutive years (see Table 1). The good news is that the preliminary estimates of returning adults in 2015 look to have recovered somewhat in comparison with the last two years (see Figure 2). The run of two-sea-winter fish has been particularly strong, reflecting a very strong smolt run in 2013 (see Figure 1).

2015 marked the start of a new joint project between the GWCT and Cefas, where we will assess the importance of small stream ecosystems and the impact of extreme river flow events on the production of juvenile salmonids. As part of this study,

Figure 1

Estimated spring smolt population 1995-2015



A salmon (upper) and a sea trout (lower) parr.
© Bill Beaumont/GWCT

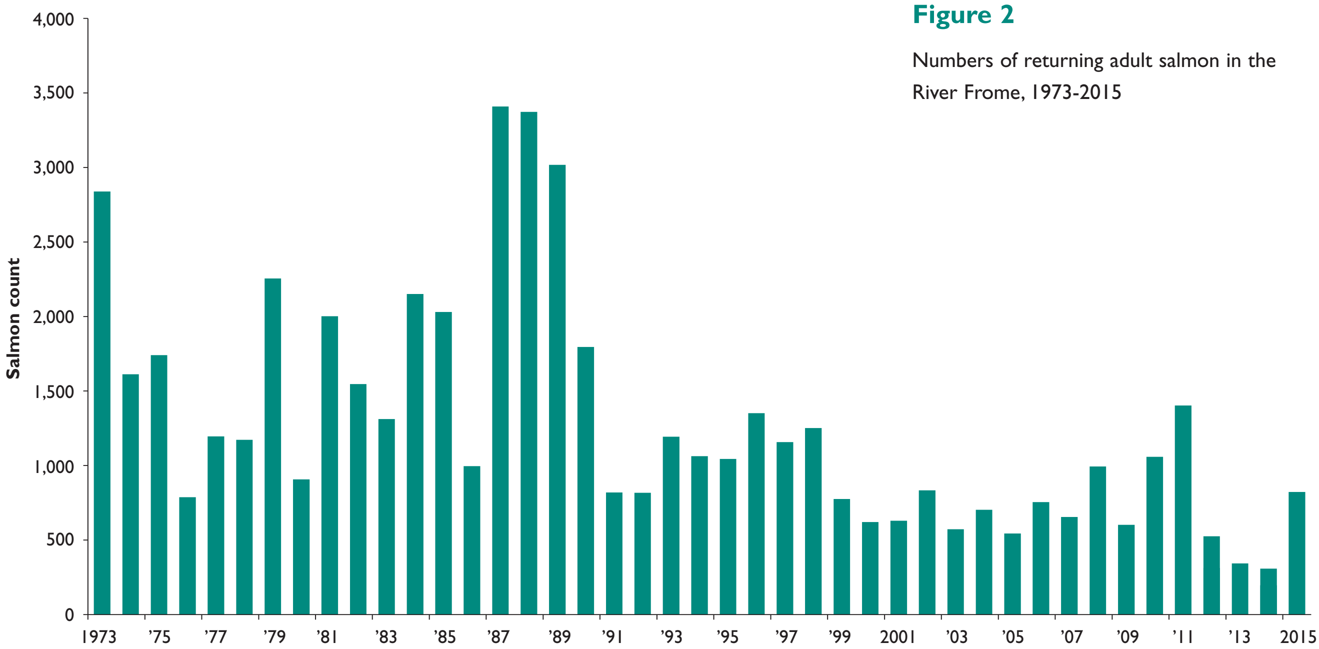


Figure 2

Numbers of returning adult salmon in the River Frome, 1973-2015

we fished more tributaries of the Frome and higher up in the catchment than ever before during the 2015 tagging. Furthermore, in addition to the usual tagging of salmon, we also tagged nearly 3,000 young trout parr. The Frome has substantial numbers of migratory trout, and with the PIT reader infrastructure in place, we are now going to try to better understand the population dynamics, migration patterns and life history traits of these migratory trout. The aim is to tag trout on a scale that will provide us with enough data to answer important ecological questions such as which part of the catchment contributes most to the migratory trout population and whether this is driven by variation in productivity or is as simple as distance from the sea.

After a very dry summer, the autumn rain arrived early in 2015 and during the first week of tagging we had more than 80mm of rain: the same as the total amount for the three months leading up to the tagging. The rain resulted in logistical headaches and cancelled electro-fishing trips, but at the end of September we had tagged 8,500 salmon and nearly 3,000 trout. We are now looking forward to tracking the migration patterns of the tagged fish.

TABLE 1

Percentage of Conservation Limit attained in the River Frome (CL) from 2004 to 2015. A Conservation Limit is the minimum spawning stock level below which the stock should not be allowed to fall. ***Source: CEFAS: Salmon stocks and fisheries in England and Wales, 2015***

Year	Percentage of CL attained
2004	124
2005	98
2006	142
2007	111
2008	161
2009	102
2010	179
2011	239
2012	93
2013	57
2014	**52**

BACKGROUND

At the Salmon & Trout Research Centre at East Stoke we carry out research on all aspects of salmon and trout life history and have monitored the run of adult salmon on the River Frome since 1973. The installation of full river coverage PIT-tag systems in 2002 facilitated the study of life history traits of salmon and trout at not only population level, but also at the level of individuals. The PIT-tag installation also enabled us to quantify the smolt output. The River Frome is one of only 14 index rivers around the North Atlantic to report on the marine survival of wild salmon populations to the International Council for the Exploration of the Sea (ICES).

ACKNOWLEDGEMENTS

We are grateful for financial support from the Environment agency for our salmon work.

MorFish - protecting Atlantic salmon

The River Scorff in Brittany, France. © INRA

For the last three years, we have been collaborating on the MorFish (Monitoring for Migratory Fish) Project with scientists at the French National Institute for Agricultural Research (INRA).

The GWCT and INRA hold between 25 and 40 years of detailed data on salmon and other migratory fish on the rivers Frome (Dorset, UK), Scorff (Brittany, France) and Oir (Normandy, France) (see Figure 1). These rivers provide regional information on the status of migratory fish stocks. They also form part of a network of 'index rivers' that report salmon data to the International Council for the Exploration of the Sea (ICES), which advises European Governments on the current status and management of migratory fish stocks. Salmon and other migratory species including sea trout, eel and lamprey need our help because their populations are threatened by the same factors threatening wildlife across the globe, namely habitat alteration, climate change, pollution and over-exploitation. Ultimately, MorFish will contribute to the long-term conservation of wild salmon populations. MorFish will meet this challenge by breaking down barriers to international co-operation and knowledge-sharing, and delivering findings from large historical datasets.

The project had three key objectives: (1) to collate and analyse long-term salmon datasets; (2) to harmonise the methods used to collect those data; and (3) to expand the salmon-monitoring programmes to other migratory fish.

KEY FINDINGS

- MorFish was a successful, productive collaboration between English and French research institutions and enduring friendships.
- Uniquely large and long-term datasets were produced on condition, number and migration timing of salmon in the MorFish rivers.
- Salmon parr are shrinking in size in three rivers in north-west France and south-west England, perhaps due to changes in climate and flow.
- A statistical framework was produced to estimate spawning salmon numbers from noisy and incomplete automatic fish counter datasets.

Stephen Gregory

What has MorFish delivered?

Most pertinent among the outputs is a successful and productive collaboration between England and France on issues relating to salmon protection. For the duration of the three-year project, the GWCT and INRA have been sharing and exchanging knowledge and expertise on salmon-monitoring methods and their application. These cross-border exchanges have given rise to three European demonstration sites with harmonised collection of efficient salmon-monitoring data. These have helped the GWCT and INRA to identify gaps in our knowledge and expertise where we might seek collaboration and co-operation in the future.

MorFish has also delivered results on two research projects: (1) a study of changing salmon parr sizes in north-west France and south-west England; and (2) a method to estimate spawning salmon stock from validated automatic fish counters. Aside from the results from these research projects, the collaboration between GWCT and INRA

Figure 1

Rivers Frome (Dorset, UK), Oir (Normandy, France) and Scorff (Brittany, France) whose data were analysed in MorFish. © INRA/GWCT

scientists has also delivered improved statistical techniques and uniquely large historical salmon-monitoring datasets.

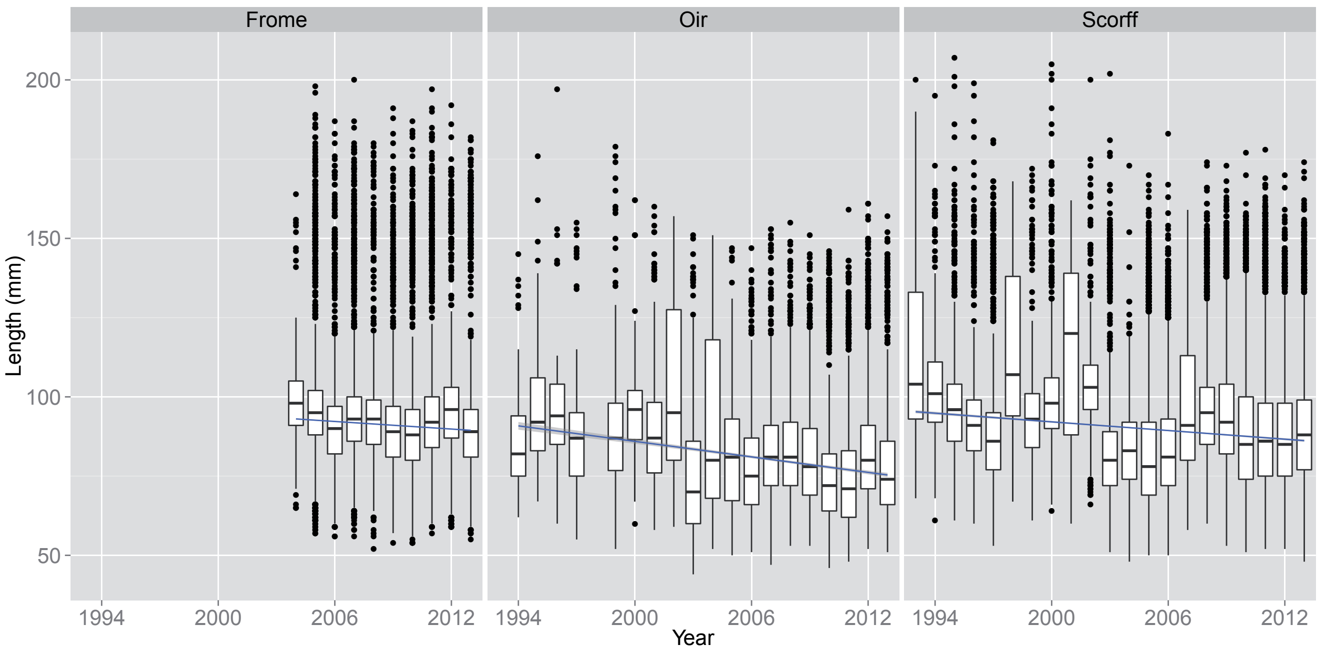
Environmental drivers of changing salmon parr lengths

Changes in parr condition, notably length, could be responsible for recent decreases in Atlantic salmon abundance, either by reducing the number or timing of salmon smolts migrating to sea or by reducing their condition and consequently their survival at sea. Yet, few studies have shown that between year changes in salmon parr lengths are correlated with environmental factors.

Salmon parr have been monitored on the Frome, Oir and Scorff for 10-25 years. The length of each individual parr captured – of which there are approximately 100,000 – is measured. With such a large, unique dataset of salmon parr from two countries, we have been able to describe observed parr length changes and how they have been affected by river temperature, flow, or numbers of competitors for food or habitat. For example, lengths of salmon parr in the Frome have been decreasing by approximately 4mm per year. And this decline appears to be associated with parr density in September, over-winter water temperature and minimum summer water

Figure 2

Boxplots of Atlantic salmon lengths over time for MorFish rivers: the Frome (Dorset, UK), Oir (Normady, France) and Scorff (Brittany, France). The blue line shows the trend in median length over the period



Salmon parr in the River Frome have been decreasing in length by approximately 4mm per year. © Bill Beaumont/GWCT

Monitoring salmon on the River Scorff. © INRA

flow. It seems that Frome salmon parr are shortest in years when there are many other salmon parr in the river and thus high competition for food, cold over-winter temperatures causing slower and later egg development and a summer drought that concentrates food and shelter and intensifies competition.

The findings of this project have highlighted the need to manage salmon parr habitat on specific rivers but have also highlighted the need for international co-operation to safeguard populations under future climate change.

Estimating salmon stocks from automatic fish counters

Salmon stocks worldwide are quantified using automatic fish counters. In principle, automatic fish counters count the number of salmon passing the device with little human intervention. In reality, the data must be validated to ensure salmon are being counted, and data missing owing to periods of malfunction must be accounted for statistically.

Installing new antennae that will count the number of salmon on the River Frome. © Dylan Roberts/GWCT

We have developed a probabilistic framework to estimate consistent daily salmonid counts from noisy and incomplete automatic fish counter data. The framework accounts for incomplete validation, periods of malfunction, and covariates of salmonid movement rates. It will be tested using synthetic data and then applied to 15 years of River Frome salmonid counter data.

Our motivation for developing the framework was to estimate stocks of salmon (or other species of interest) on the Frome but also on 'data-poor' or, more specifically, 'information-poor' rivers. We plan to hold a workshop with automatic fish counter managers and scientists in 2016 to encourage dissemination and uptake of the framework.

MorFish conference

On 3-4 March 2015, the project held its closing conference close to the banks of the River Frome in Dorset. The event was attended by over 90 delegates including 27 from France, and representatives from NGOs and public organisations who are involved in salmon population monitoring, assessment and management. The list of delegates included some key players in the salmon world, and the MorFish Project team would like to issue a huge thank you to everyone who attended.

Day one of the event was dedicated to discussing the salmon monitoring undertaken in England, Wales and France and the techniques used. This included talks by Ian Davidson, who leads the salmon monitoring for Natural Resources Wales, and Jean-Luc Bagliniere, who gave an overview of current and historical salmon data collection and management in France.

Day two focused on how the collected data are being used or could be interrogated using contemporary data-modelling techniques to further our understanding of what drivers cause changes in salmon abundance. We also presented our work on modelling changes in salmon parr lengths over the last 25 years and how to fill gaps in data in salmon population estimates using contemporary modelling techniques. There was particular reference to monitoring on salmon index rivers presented by Etienne Prevost from INRA and how modelling of data could be used to increase the precision of setting conservation limits on rivers.

For the talks presented at the event, please visit **www.morfish.org.uk**.

A MorFish education day was held at Pont Scorff. © INRA

BACKGROUND

For the last three years, we have been collaborating on the MorFish (Monitoring for Migratory Fish) Project with scientists at the French National Institute for Agricultural Research (INRA). MorFish was part-funded by the EU's Interreg Channel IV4A programme and ended in June 2015.

MorFish
Monitoring for Migratory Fish

Game & Wildlife
CONSERVATION TRUST

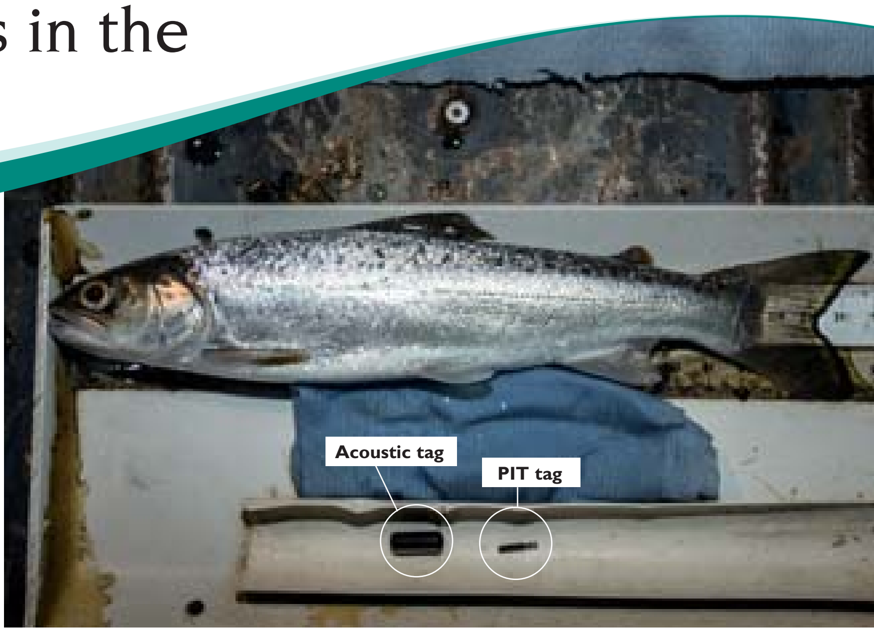
INRA
SCIENCE & IMPACT

Interreg

European Union

(L-R) Dr Marie Nevoux and Dr Jean-Marc Roussel from INRA, Luke Scott, Dylan Thomas, Paul Knight (S&TC) and Rasmus Lauridsen from the GWCT at the MorFish Conference. © INRA

Sea trout smolts in the River Frome



A sea trout smolt ready to be fitted with acoustic and PIT tags (circled). © Bill Beaumont/GWCT

KEY FINDINGS

- Seaward migration of trout smolts was associated with significant loss rates in the lower-river and estuary.
- No zone stood out as having a particular high loss rate, though the loss rate per distance was slightly higher in the saline part of the migration.
- Smolts migration in freshwater was almost exclusively at night, presumably a predator avoidance behaviour.

Rasmus Lauridsen

BACKGROUND

Among salmonids, brown trout *(Salmo trutta)* exhibit one of the most polytypic life histories: with some individuals migrating to the marine environment before returning to spawn, some staying in their freshwater natal stream all their life, with others 'doing something in between'. Technological advances have improved our ability to collect migration data from the marine environment thereby enabling us to better analyse the costs and benefits of the different strategies.

The migration between freshwater nursing grounds and saltwater feeding areas is a key stage in the life history of sea trout. During their seaward migration, smolts encounter both natural and man-made obstructions, as well as increased exposure to predators. This is particularly true in the transition zone between fresh and saltwater, where smolts experience new physiological stressors and encounter new predators.

We used acoustic tags to study the migration behaviour and loss rate of sea trout smolts in the lower River Frome and its estuary, Poole Harbour. Unlike radio tags and PIT tags, acoustic tags actively transmit a signal that can be heard effectively in the marine environment. Fifty one smolts were captured on an eel rack 21 kilometres (km) upstream of the saline limit during their downstream migration in the spring of 2014. The captured individuals were measured, weighed and fitted with an acoustic transmitter (see above). The movement of the smolts through the lower river and within the estuary was recorded by acoustic receivers positioned in the lower river and throughout Poole Harbour (see Figure 1).

Observations of the smolts in freshwater were almost exclusively made at night, whereas there was no apparent nocturnal pattern of migration in the salty environment (see Figure 2). As the main potential predators in the freshwater environment (pike and cormorant) mainly forage during the day, we believe that the night-time migration in freshwater is a predator-avoidance strategy.

The median time taken for the trout to migrate the 21km from the trap to the saline limit was 3.5 days whereas the 12km migration from saline limit to the exit of the estuary took 1.5 days. The efficiency of the acoustic receivers was very good, operating at >90% and >80% efficiency for receivers in freshwater and saltwater respectively. Taking the receiver efficiencies into account, the total loss rate of smolts over the 33km between the eel rack and the exit of Poole Harbour was 24%. Smolts were lost throughout the length of the study area, and no zones stood out as having particularly high loss rates, though the loss rate per distance travelled was slightly higher in the salty environment than in freshwater.

Waiting for smolts to be washed onto the eel rack. © Bill Beaumont/GWCT

This study illustrates that there is a considerable cost/risk associated with migrating to sea. However, the potential gain in terms of increased growth rate due to richer feeding grounds and therefore lifetime fecundity is well established, particularly for females where the number of eggs is directly related to body length.

The last observation in the harbour was made on 15 May; no further tags were detected until 22 July when the first individual was detected re-entering the estuary. A further four individuals were detected re-entering the estuary between 22 July and the end of the lifespan of the batteries (mid-August). All five individuals were observed entering the freshwater zone of the river within 20 hours of being observed at the mouth of the estuary. These data suggest that the tagged trout, at least in 2014, did not forage in Poole Harbour during the summer and that individuals re-entered the estuary as part of a migration back to the river. Having invested much energy in smoltification and undertaken the high-risk journey to sea, re-entering the river only months after leaving and several months before their first potential spawning is a strategy that fisheries scientists are still trying to understand.

Figure 1

Locations of acoustic receivers in Poole Harbour with the dot size indicating their approximate detection range. The numbers indicate the number of tags detected by that receiver

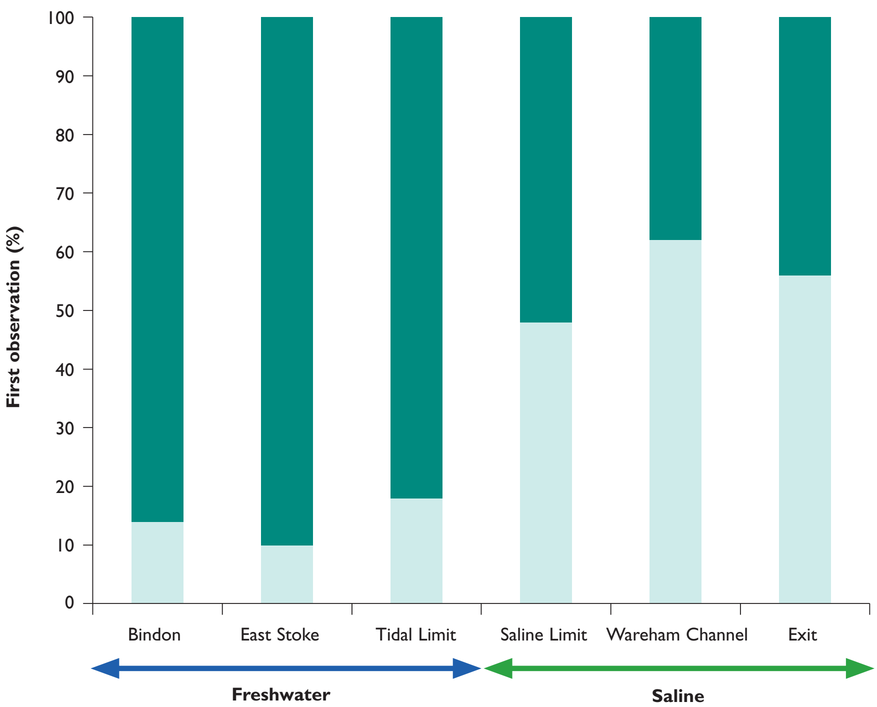


Figure 2

Distribution of time of day tag observations at individual observation stations

Night

Day

ACKNOWLEDGEMENTS

We are grateful for financial support from Kimbridge on Test, Sir Chips Keswick, Anthony Daniel and Winton Capitol. Also the collaboration with our colleagues at Cefas on this project and the Weld Estate for access to the river.

Research projects

by the Game & Wildlife Conservation Trust in 2015

LOWLAND GAME RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Pheasant population studies	*Long-term monitoring of breeding pheasant populations on releasing and wild bird estates*	*Roger Draycott, Maureen Woodburn, Rufus Sage*	*Core funds*	*1996- on-going*
Game marking scheme	*Study of factors affecting return rates of pheasant release pens*	*Rufus Sage, Maureen Woodburn,*	*Core funds*	*2008- on-going*
Farmland birds and game	*Monitoring the response of birds to changes in farmland habitat and management*	*Roger Draycott*	*Sandringham Estate*	*2009- on-going*
Grey partridge management	*Researching and demonstrating grey partridge management in Scotland*	*Dave Parish, Hugo Straker, Adam Smith, Gemma Davis, Anna McWIlliam*	*Whitburgh Farms, Mains of Loriston Trust*	*2011-2020*
Grey partridge recovery	*Monitoring grey partridge recovery and impacts on associated wildlife*	*Dave Parish, Anna McWilliam, Hugo Straker*	*Core funds, Kingdom Farming, Kings Seeds*	*2014-2018*
Game crops	*Developing perennial game cover mixes*	*Dave Parish, Anna McWilliam, Hugo Straker*	*Core funds, Kingdom Farming, Kings Seeds*	*2014-2018*
Pheasant releasing on Exmoor	*Impacts of released pheasants and game management work on woodlands and farmland in Exmoor*	*Rufus Sage, Aidan Hulatt, Jenny Peach, Alice Deacon*	*Greater Exmoor Shoot Association*	*2015-2016*
GWSDF Auchnerran baseline monitoring	*Wide-ranging environmental audit to establish a baseline for biodiversity*	*Dave Parish, Alison Espie, Lydia Murphy, Andy Clark, Charlotte Ivison*	*Core funds*	*2015-on-going*
GWSDF Tarland farmer cluster	*Establishing the first farmer cluster in Scotland*	*Dave Parish, Alison Espie, Lydia Murphy, Andy Clark, Charlotte Ivison*	*MacRobert Trust*	*2015-2016*
PhD: Breeding birds in biomass crops (see p18)	*Breeding success of ground and hedgerow nesting birds in miscanthus and SRC*	*Henrietta Pringle Supervisors: Rufus Sage, Prof Simon Leather/Harper Adams University*	*NERC/CASE, Core funds*	*2011-2015*
PhD: Pheasant behaviour and the rearing system	*Improving behavioural and physiological adaption of reared pheasants to the wild*	*Mark Whiteside Supervisors: Rufus Sage, Jack Buckingham Dr Joah Madden/Exeter University*	*Exeter University, Middleton Estate, Core funds*	*2012-2015*
PhD: Gapeworm and pheasants	*Gapeworm on shooting estates, spatial and temporal factors affecting infections in pheasants*	*Owen Gethings Supervisors: Rufus Sage Prof Simon Leather (Harper Adams University)*	*BBSRC/CASE Studentship, Core funds*	*2014-2017*
PhD: Corvids breeding on farmland (see p14)	*Breeding ecology of corvids, predatory behaviour and the effect of trapping on farmland*	*Lucy Capstick. Supervisors: Rufus Sage, Dr Joah Madden (Exeter University)*	*Songbird Survival*	*2014-2017*
PhD: Improving released pheasants	*Using improved hand-reared pheasants to increase survival and wild breeding post-release*	*Andy Hall. Supervisors: Rufus Sage, Dr Joah Madden (Exeter University)*	*Exeter University, Core funds*	*2015-2018*

WETLAND RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Woodcock monitoring	*Examination of annual variation in breeding woodcock abundance*	*Andrew Hoodless, Chris Heward, Collaboration with BTO*	*Shooting Times Woodcock Club*	*2003- on-going*
Woodcock migration	*Use of satellite tags and geolocators to examine woodcock migration strategies*	*Andrew Hoodless,Chris Heward*	*Shooting Times Woodcock Club, private donors, Woodcock Appeal*	*2010-2015*
Lapwings on fallow plots	*Assessment of lapwing breeding success on AES fallow plots*	*Andrew Hoodless, Kaat Brulez, Carlos Sanchez, Collaboration with RSPB*	*Defra, The Dulverton Trust, The Manydown Trust, private donor*	*2012-2016*
National breeding woodcock survey (see p20)	*Randomized survey to produce country population estimates and assess change since 2003*	*Andrew Hoodless, Chris Heward, Collaboration with BTO*	*Core funds, Shooting Times Woodcock Club*	*2013-2015*
Strategies for coping with cold weather in woodcock (see p22)	*Examination of regulation of fat reserves, estimation of duration to starvation and behavioural responses*	*Andrew Hoodless, Carlos Sanchez*	*Private donors, Core funds*	*2014-2017*
LIFE Waders for Real	*Wader recovery project in the Avon Valley*	*Andrew Hoodless, Lizzie Grayshon*	*EU Life+*	*2014-2018*
PhD: Landscape-scale effects of game management	*Evaluation of relative importance of landscape and local management influences on species distribution and abundance*	*Jessica Newman Supervisors: Andrew Hoodless, Dr Graham Holloway/Reading University*	*Core funds, Private funds, Forestry Commission*	*2010-2015*
PhD: Factors influencing breeding woodcock abundance	*Landscape-scale and fine-scale habitat relationships of breeding woodcock and investigation of drivers of decline*	*Chris Heward Supervisors: Andrew Hoodless, Prof Rob Fuller/BTO, Dr Andrew MacColl/ Nottingham University*	*Private funds, core funds*	*2013-2018*

PARTRIDGE AND BIOMETRICS RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Partridge Count Scheme (see p24)	*Nationwide monitoring of grey and red-legged partridge abundance and breeding success*	*Neville Kingdon, Nicholas Aebischer, Julie Ewald, Sophie Watts, Georgina Tucker, William Connock, Emma Popham*	*Core funds, GCUSA*	*1933- on-going*

National Game-bag Census (see p30)	Monitoring game and predator numbers with annual bag records	Nicholas Aebischer, Gillian Gooderham, Ryan Burrell, Sophie Watts, Georgina Tucker, William Connock, Emma Popham, Sebastian Aebischer	Core funds	1961- on-going
Sussex study (see p28)	Long-term monitoring of partridges, weeds, invertebrates, pesticides and land use on the South Downs in Sussex	Julie Ewald, Nicholas Aebischer, Steve Moreby, Ryan Burrell, Dr Dick Potts (consultant)	Core funds	1968- on-going
Partridge over-winter losses	Identifying reasons for high over-winter losses of grey partridges in the UK	Nicholas Aebischer, Francis Buner,	Core funds, GCUSA	2007-2016
Loddington-Hope Farm comparison (see p60)	Comparison of farm management and trends in bird abundance at Loddington Farm and Hope Farm	Nicholas Aebischer, Chris Stoate	Core funds	2010-2015
Wildlife monitoring at Rotherfield Park (see p26)	Monitoring of land use, game and songbirds for the Rotherfield demonstration project	Francis Buner, Malcolm Brockless, Peter Thompson, Roger Draycott, Julie Ewald	Core funds	2010-2018
Capacity building in Himachal Pradesh, India	Bird ringing, monitoring and Galliform re-introduction capacity building for Himachal Pradesh Wildlife Department	Francis Buner	Forest and Wildlife Department of Himachal Pradesh	2013- on-going
Cluster Farm mapping	Generating cluster-scale landscape maps for use by the Advisory Service and the Farm Clusters	Julie Ewald, Neville Kingdon, Sophie Watts, Georgina Tucker, William Connock, Emma Popham	Core funds	2014- on-going
Invertebrate database management	Modernise and standardise the software for the Sussex and Loddington invertebrate databases	Julie Ewald, Nicholas Aebischer, Philip Nasser, Ryan Burrell	Core funds	2015-2016

UPLANDS RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Grouse Count Scheme (see p34)	Annual grouse and parasitic worm counts in relation to moorland management indices and biodiversity	David Baines, David Newborn, Mike Richardson, Kathy Fletcher, Phil Warren, David Howarth	Core funds, Gunnerside Estate	1980- on-going
Long-term monitoring of breeding ecology of waders in the Pennine uplands	Annual measures of wader density, lapwing productivity, recruitment and survival	David Baines, Harriet Fuller	Core funds	1985- on-going
Black grouse monitoring	Annual lek counts and brood counts	Philip Warren, David Baines, David Newborn, Matteo Anderle	Core funds	1989- on-going
Capercaillie brood surveys	Surveys of capercaillie and their broods in Scottish forests	Kathy Fletcher, David Baines, David Howarth, Mike Richardson, Phil Warren, Amy Withers	SNH, Forest Enterprise Scotland	1991- on-going
Timing of breeding in red grouse	Long-term assessment of changes in laying dates in relation to climate change	David Howarth, Kathy Fletcher, Amy Withers	The Samuels Trust, Core funds	1995- on-going
Black grouse range expansion (see p42)	Black grouse range restoration in the Yorkshire Dales by translocating surplus wild males	Philip Warren, Matteo Anderle, Nancy Parsons	Biffa, Private funder, Yorkshire Water, Nidderdale AONB	1996-2016
Langholm Moor Demonstration Project (see p44)	Research data for moorland restoration to achieve economically-viable driven grouse shooting and sustainable numbers of hen harriers	Sonja Ludwig, David Baines, Emily Trevail, Hannah Greetham	Core funds, Buccleugh Estates, SNH, Natural England, RSPB	2008-2018
Alternative grouse diseases	Cryptosporidiosis in red grouse: study of spread of disease, prevalence and impacts on grouse survival and fecundity	David Baines, Mike Richardson, David Newborn, Harriet Fuller, Rhodri Evetts, Nancy Parsons, Helen Allinson	Core funds, G and K Boyes Trust, Derbyshire & South Yorkshire County Group, Anonymous donors	2013-2016
The effects of heather burning and peat depth on densities and productivity of red grouse	Analysis of long-term grouse monitoring data in relation to burning indices and peat depth measurements across core sites in northern England	David Baines, Gail Robertson	Core funds	2014-2015
Capercaillie genetics	How accurately can non-invasive genetical techniques be used to estimate population size	Kathy Fletcher, David Baines, Amy Withers	Royal Zoological Society Scotland, SNH	2014-2015
Captive bred black grouse and range extension	Desk study that considers whether captive bred birds can be used to augment naturally expanding populations at the edge of the current range	Philip Warren	World Pheasant Association	2014-2015
The Berwyn, Migneint and Radnor Hills Moorland Recovery Project	Monitoring the effects of and advising on methods to help restore grouse and other wildlife in parts of the Welsh uplands, including development of European funding bids for longer term management	David Baines, Merlin Becker, Paul Stephens, Rhodri Evetts	Welsh Government's Nature Fund	2014-2015
Black grouse in Wales	Analysis of interaction of habitat and predator management in determining increases in black grouse at Ruabon Moor	David Baines, Merlin Becker, Rhodri Evetts	World Pheasant Association	2014-2016
Capercaillie, martens and generalist predators	Development work for anticipated trial that experimentally considers the role of martens and other generalist predators in determining capercaillie breeding success	Kathy Fletcher	SNH, Forestry Commission Scotland, Cairngorms National Park Authority	2014-2016
How best to count mountain hares	Test of a variety of count methods used to determine local densities of mountain hares	Scott Newey (JHI), Kathy Fletcher Helen Allinson, Rhodri Evetts	SNH, James Hutton Institute	2014-2016

Black grouse in southern Scotland	*Development of recovery protocol*	*Philip Warren, Nancy Parsons*	*SNH, Southern Uplands Partnership, RSPB, FES*	*2015-2016*
PhD: Impacts of buzzards on red grouse (see page 38)	*Dietary studies of breeding buzzards and foraging patterns in relation to grouse survival*	*Richard Francksen Supervisors: David Baines, Mark Whittingham/University of Newcastle*	*Langholm Moor Demonstration Project University of Newcastle*	*2012-2015*

FARMLAND RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
People and pollinators in India	*To improve understanding of native Indian pollinators, their ecology and best practice management*	*Barbara Smith*	*Darwin Initiative*	*2012-2015*
QuESSA (see p50)	*Quantification of Ecological Services for Sustainable Agriculture*	*John Holland, Barbara Smith, Niamh McHugh, Steve Moreby, Tom Elliott, David Stevenson, Laura James, Emily Robertson, Belinda Bown, Jasmine Clark*	*EU FP7*	*2013-2017*
Aphid infestations in autumn	*Investigating influence of landscape features on autumn aphid infestations in cereals*	*John Holland, Jasmine Clark, Belinda Bown, Tom Elliott*	*Core funds*	*2015- on-going*
Insecticide effects on beneficial invertebrates	*Secondary feeding effects of insecticides on beetles*	*John Holland, Laura James, Tom Elliott*	*Core funds*	*2015- on-going*
PhD: Farmland birds and agri-environment schemes	*The breeding success of farmland birds and the impact of agri-environment scheme habitats*	*Niamh McHugh Supervisors: John Holland, Professors Mick Crawley and Simon Leather (Imperial College London)*	*BBSRC/CASE studentship, NE*	*2012-2015*
PhD: Bumblebees and agri-environment schemes (see p46)	*How effective are agri-environment schemes in boosting bumblebee populations?*	*Tom Wood Supervisors: John Holland, Professor Dave Goulson (University of Sussex)*	*NERC/CASE studentship*	*2013-2016*

ALLERTON PROJECT RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Monitoring wildlife at Loddington	*Annual monitoring of game species, songbirds, invertebrates, plants and habitat*	*Chris Stoate, John Szczur, Alastair Leake, Steve Moreby*	*Allerton Project funds*	*1992- on-going*
Effect of game management at Loddington (see p52)	*Effect of ceasing predator control and winter feeding on nesting success and breeding numbers of songbirds.*	*Chris Stoate, Alastair Leake, John Szczur*	*Allerton Project funds*	*2001- on-going*
School farm catchment	*Practical demonstration of ecosystem services*	*Chris Stoate, John Szczur*	*Allerton Project, EA, Anglian Water, Agrii SoilQuest*	*2012- on-going*
MICROCAT Microwave Assisted Catalytic Treatment of Agricultural Wastewater	*Development of technology for the removal of pesticides and other pollutants from agricultural waste water*	*Chris Stoate, Loughborough and Leicester de Montfort universities and other partners, John Szczur*	*Technology Strategy Board*	*2012-2015*
Water Friendly Farming (see p58)	*A landscape scale experiment testing integration of resource protection and flood risk management with farming in the upper Welland*	*Chris Stoate, John Szczur, Jeremy Briggs, Penny Williams, Adrianna Hawczak, Anita Casey (Freshwater Habitats Trust), Professor Colin Brown (University of York)*	*EA, Syngenta, Chemicals Regulation Directorate, Anglian Water*	*2012- on-going*
Remote sensing data applications	*An investigation into the potential uses of remote sensing and ground sourced data for catchment management*	*Chris Stoate, Antony Williamson (EA), Crispin Hambidge (Geomatics), Georgina Wallis (CSF)*	*EA/CSF*	*2013-2015*
Sustainable Intensification Platform Project 1	*Farm-scale assessment of soil properties in relation to crop establishment and cover crops, and sheep performance in relation to sward minerals*	*Chris Stoate, Felicity Crotty, Nicola Hinton, Phil Jarvis, Alastair Leake, Jim Egan, Ron Stobart (NIAB), Nigel Kendall (Nottingham University)*	*Defra*	*2014-2017*
Sustainable Intensification Platform Project 2	*Landscape scale assessment of potential for collaborative interventions to meet sustainable Intensification objectives*	*Chris Stoate, Exeter and Nottingham Universities and other partners*	*Defra*	*2014-2017*
Soil monitoring	*Survey of soil biological, physical and chemical properties*	*Chris Stoate, Felicity Crotty, Nicola Hinton, Alastair Leake, Phil Jarvis*	*Allerton Project*	*2014- on-going*
VALERIE	*Farmer oriented participatory research into biological mobilisation of soil P*	*Chris Stoate, Jim Egan*	*EU*	*2015-2017*
PhD: Soil compaction and biology	*The relationship between arable soil compaction, earthworms and microbial activity*	*Falah Hamad. Supervisors: Chris Stoate, David Harper (Leicester University)*	*Leicester University*	*2014-2017*
PhD: Farmer and scientific knowledge of soils	*A comparison of farmers' perceptions of soils and those of scientists and policy makers with societal objectives*	*Stephen Jones. Supervisors: Chris Stoate, Carol Morris, Sacha Mooney (Nottingham University)*	*ESRC*	*2015-2018*
PhD: Multifunctional field margins	*An experimental comparison of plant species communities designed for pollinators, pest predators/parasitoids, and water run-off management*	*Claire Blowers. Supervisors: Chris Stoate, Heidi Cunningham, Peter Sutton, Nigel Boatman*	*BBSRC Syngenta CASE*	*2015-2018*

PREDATION RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Fox control methods	*Experimental field comparison of fox capture devices*	*Jonathan Reynolds, Mike Short*	*Core funds*	*2002- on-going*
Tunnel traps (see p64)	*Experimental field comparison of tunnel traps and methods of use*	*Jonathan Reynolds, Mike Short*	*Core funds*	*2008- on-going*
Grey squirrel trapping strategy	*Exploratory research on optimal trapping strategy for grey squirrel control*	*Jonathan Reynolds, Mike Short*	*Core funds*	*2013-2016*
PhD: Pest control strategy	*Use of Bayesian modelling to improve control strategy for vertebrate pests*	*Tom Porteus. Supervisors: Jonathan Reynolds, Prof. Murdoch McAllister (University of British Columbia, Vancouver)*	*Core funds, University of British Columbia*	*2006-2015*

FISHERIES RESEARCH IN 2015

Project title	Description	Staff	Funding source	Date
Fisheries research	*Develop wild trout fishery management methods including completion of write-up/reports of all historic fishery activity*	*Dylan Roberts*	*Core funds*	*1997- on-going*
Monnow habitat improvement project	*Large-scale conservation project and scientific monitoring of 30 kilometres of river habitat on the River Monnow in Herefordshire*	*Dylan Roberts, Sian Griffiths Janine Burnham*	*Defra, Rural Enterprise Scheme, Monnow Improvement Partnership, KESS EU*	*2003- on-going*
Salmon life-history strategies in freshwater (see p68)	*Understanding the population declines in salmon*	*Rasmus Lauridsen, Dylan Roberts, William Beaumont, Luke Scott, Stephen Gregory*	*Core funds, EA, CEFAS, Mr A Daniell, Winton Capital*	*2009- on-going*
Salmon smolt rotary screw trap assessment	*Calculating the effects of rotary screw traps on salmon smolts*	*Rasmus Lauridsen, Dylan Roberts, Luke Scott William Beaumont, Stephen Gregory, Bill Riley*	*CEFAS, Core funds*	*2009- on-going*
Grayling Ecology	*Long-term study of the ecology of River Wylye grayling*	*Stephen Gregory, Luke Scott*	*NRW, Core funds, Grayling. Research Trust, Piscatorial Society*	*2009- on-going*
Juvenile salmon and hydro	*The effects of a Hydropower installation on salmon smolts*	*Rasmus Lauridsen, William Beaumont, Graeme Storey (EA)*	*EA, core funds, Salmon & Trout Conservation UK, Lulworth Estate*	*2012-2015*
MorFish (see p70)	*Alignment of data collection on the Rivers Frome, Oir and Scorff. Technical development of PIT equipment on these rivers*	*Dylan Roberts, Jean-Marc Roussel and Didier Azam (INRA), William Beaumont, Rasmus Lauridsen, Stephen Gregory*	*Core funds, INRA, EU Interreg Channel programme*	*2012-2015*
MorFish	*An international collaboration to model historical fish populations using state of the art Bayesian theory*	*Stephen Gregory, Jean-Marc Roussel, Etienne Rivot, Marie Nevoux*	*Core funds, INRA, EU Interreg Channel Programme*	*2012-2015*
Sea trout smolt survival (see p74)	*Monitoring sea trout smolts through the lower Frome and it's estuary, Poole harbour*	*Rasmus Lauridsen, William Beaumont, Luke Scott*	*Sir Chips Keswick, Anthony Daniell, Winton Capital, Clay Brendish Foundation*	*2014-2015*
Gyrodactylus salaris in salmon	*Modelling to predict the impacts Gyrodactylus salaris infection of salmon stocks*	*Rasmus Lauridsen, Alastair Cook, Nicola McPherson and Nick Taylor*	*Cefas/Defra, Core funds*	*2015-2019*
Headwaters and salmonids	*Contribution of headwaters to migratory salmonid populations and the impacts of extreme events*	*Rasmus Lauridsen, William Beaumont, Luke Scott, Dylan Roberts, Stephen Gregory, Bill Riley*	*Cefas/Defra, Core funds*	*2015-2019*
Flows and Frome Salmon redd distribution	*How does flow affect the inter-annual distribution of salmon redds in the Frome*	*Stephen Gregory, Rasmus Lauridsen, Dylan Roberts, Sian Griffiths (Cardiff University), Elinor Parry*	*KESS (EU), Core funds*	*2015-2016*
PhD: Beavers and Salmonids	*Impacts of beaver dams on salmonids*	*Robert Needham. Supervisors: Dylan Roberts, Paul Kemp (Southampton University)*	*Core funds, Southampton University, Scottish National Heritage, Salmon & Trout Conservation UK*	*2014-2017*
PhD: Ranunculus as a bioengineer in chalkstreams	*Investigate the role of Ranunculus as a bioengineer, driving the abundance and diversity of plants, invertebrates and fish, with particular focus on salmonids*	*Jessica Marsh. Supervisors: Rasmus Lauridsen, Iwan Jones (QMUL)*	*G and K Boyes Trust*	*2015-2019*
PhD: Impact of low flows on salmonid river ecosystems	*Investigate fish prey availability, the diet of trout and salmon, stream food webs and ecosystem dynamics under differing, experimentally manipulated flow conditions*	*Jessica Picken. Supervisors: Rasmus Lauridsen, Iwan Jones (QMUL), Bill Riley (Cefas), Sian Griffiths (Cardiff University)*	*QMUL, Cefas, Core funds*	*2015-2018*

Key to abbreviations: AONB = Areas of Outstanding Natural Beauty; BBSRC = Biotechnology and Biological Sciences Research Council; CASE = Co-operative Awards in Science & Engineering; CEFAS = Centre for Environment, Fisheries & Aquaculture Science; CSF = Catchment sensitive farming; Defra = Department for Environment, Food and Rural Affairs; EA = Environment Agency; ESRC = Economic & Social Research Council; EU = European Union; FES = Forest Enterprise Scotland; GCUSA = Game Conservancy USA; HGCA = Home Grown Cereals Authority; INRA = French National Institute for Agricultural Research; KESS = Knowledge Economy Skills Scholarships; NE = Natural England; NERC = Natural Environment Research Council; NRW = Natural Resources Wales; QMUL = Queen Mary University of London; RSPB = Royal Society for the Protection of Birds; SNH = Scottish Natural Heritage

Scientific publications

by staff of the Game & Wildlife Conservation Trust in 2015

Armenteros, JA, **Sánchez-García, C**, Alonso, ME, Larsen, RT & Gaudioso, VR **(2015)** Use of water troughs by wild rabbits *Oryctolagus cuniculus* in a farmland area of north-west Spain. *Animal Biodiversity and Conservation,* 38: 233-240.

Armenteros, JA, **Sánchez-García, C**, Prieto, R, Lomillos, JM, Pérez, JA, Alonso, ME & Gaudioso, VR **(2015)** Do wild red-legged partridges *Alectoris rufa* use feeders? An investigation of their feeding patterns using camera trapping. *Avian Biology Research*, 8: 14-24.

Barbanera, F, Forcina, G, Cappello, A, Geurrini, M, van Grouw, H & **Aebischer, NJ** (2015) Introductions over introductions: the genomic adulteration of an early genetically valuable alien species in the United Kingdom. *Biological Invasions*, 17: 409-422.

Brulez, K, Pike, TW & Reynolds, SJ (2015) Egg signalling: the use of visual, auditory, and chemical stimuli. In: Deeming, DC & Reynolds, SJ (eds) *Nests, Eggs, & Incubation. New Ideas About Avian Reproduction,* 127-141. Oxford University Press, Oxford.

Buner, F, Dhiman, SP, Walker, T & Dhadwal, D (2015) Pioneering bird ringing-capacity building in Sairopa, Great Himalayan National Park, Himachal Pradesh, India. *Birding ASIA,* 23: 102-107.

Chakrabarti, P, Rana, S, Sarkar, S, **Smith, B** & Basu, P (2015) Pesticide-induced oxidative stress in laboratory and field populations of native honey bees along intensive agricultural landscapes in two Eastern Indian states. *Apidologie*, 46: 107-129.

Clay, GD, Worrall, F & **Aebischer, NJ** (2015) Carbon stocks and carbon fluxes from a 10-year prescribed burning chronosequence on a UK blanket peat. *Soil Use and Management*, 31: 39-51.

Eaton, MA, **Aebischer, NJ,** Brown, A, Hearn, RD, Lock, L, Musgrove, AJ, Noble, DG, Stroud, DA & Gregory, RD (2015) Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. *British Birds*, 108: 708-746.

Ewald, JA, Aebischer, NJ, Moreby, SJ & Potts, GR (2015) Changes in the cereal ecosystem on the South Downs of southern England, over the past 45 years. *Aspects of Applied Biology,* 128: 11-19.

Ewald, JA, Wheatley, CJ, Aebischer, NJ, Moreby, SJ, Duffield, SJ, Crick, HQP & Morecroft, MB (2015) Influences of extreme weather, climate and pesticide use on invertebrates in cereal fields over 42 years. *Global Change Biology,* 21: 3931-3950.

Fernandes, WPA, Griffiths, SW, **Ibbotson, AT,** Bruford, MW & Riley, WD (2015) The role of density and relatedness in wild juvenile Atlantic salmon growth. *Journal of Zoology,* 295: 56-64.

Fernandes, WPA, **Ibbotson, AT,** Griffiths, SW, Maxwell, DL, Davison, PI & Riley, WD (2015) Does relatedness influence migratory timing and behaviour in Atlantic salmon smolts? *Animal Behaviour*, 106: 191-199.

Fingland, K & **Ludwig, S** (2015) Clutch abandonment as a result of brood adoption in the red grouse *Lagopus lagopus scotica. British Birds*, 108: 294-295.

Fletcher, K, Warren, P & Baines, D (2015) Predation of well-grown capercaillie chick probably by a pine marten. *Scottish Birds*, 35: 217-218.

Francksen, RM (2015) Exploring the impact of common buzzard *Buteo buteo* predation on red grouse *Lagopus lagopus scotica.* Unpublished PhD thesis. Newcastle University, Newcastle-upon-Tyne.

Garnier, M, Harper, DM, Blaskovicova, L, Hancz, G, Janauer, GA, Jolánkai, Z, Lanz, E, Lo Porto, A, Mándoki, M, Pataki, B, Rahuel, J-L, Robinson, VJ, **Stoate, C,** Tóth, E & Jolánkai, G (2015) Climate change and European water bodies, a review of existing gaps and future research needs: findings of the Climate Water Project. *Environmental Management*, 56: 271-285.

Gethings, OJ, Sage, RB & Leather, SR (2015) Spatio-temporal factors influencing the occurrence of *Syngamus trachea* within release pens in the south-west of England. *Veterinary Parasitology,* 207: 64-71.

Gethings, OJ, Sage, RB & Leather, SR (2015) Spatial distribution of infectious stages of the nematode *Syngamus trachea* within pheasant *Phasianus colchicus* release pens on estates in the south-west of England: potential density dependence? *Veterinary Parasitology*, 212: 267-274.

Heward, CJ, Hoodless, AN, Conway, GJ, **Aebischer, NJ**, Gillings, S & Fuller, RJ (2015) Current status and recent trend of the Eurasian Woodcock *Scolopax rusticola* as a breeding bird in Britain. *Bird Study,* 62: 535-551.

Holland, JM, Smith, BM, Storkey, J, Lutman, PJW & **Aebischer, NJ** (2015) Managing habitats on English farmland for insect pollinator conservation. *Biological Conservation,* 182: 215-222.

Jönsson, AM (2015) *Effects of Created Habitats on Farmland Biodiversity.* Unpublished PhD thesis. Lund University, Lund, Sweden.

Lampkin, NH, Pearce, BD, **Leake, AR**, Creissen, H, Gerrard, CL, Girling, R, **Lloyd, S,** Padel, S, Smith, J, Smith, LG, Vieweger, A & Wolfe, MS (2015) *The role of agroecology in sustainable intensification.* Report for the Land Use Policy Group. Elm Farm Organic Research Centre and GWCT, Newbury and Fordingbridge.

MacFadyen, S, Tylianakis, JM, Letourneau, DK, Benton, TG, Tittonell, P, Perring, MP, Gómez-Creutzberg, C, Báldi, A, **Holland, JM**, Broadhurst, L, Okabe, K, Renwick, AR, Gemmill-Herren, B, Smith, HG (2015) The role of food retailers in improving resilience in global food supply. *Global Food Security,* 7, 1-8.

McHugh, NM (2015) *Breeding Farmland Birds and the Role of Habitats Created under Agri-environment Schemes.* Unpublished PhD thesis. Imperial College of London, London.

Neumann, JL, Holloway, GJ, **Sage, RB & Hoodless, AN (2015)** Releasing of pheasants for shooting in the UK alters woodland invertebrate communities. *Biological Conservation,* 191: 50-59.

Pérez, JA, **Sánchez-García, C**, Díez, C, Bartolomé, DJ, Alonso, ME & Gaudiso, VR (2015) Are parent-reared red-legged partridges *Alectoris rufa* better candidates for re-establishment purposes? *Poultry Science,* 94: 2330-2338.

Porteus, TA (2015) *Evaluation of Restricted-Area Culling Strategies to Control Local Red Fox Density.* Unpublished PhD thesis. University of British Columbia, Vancouver, Canada.

Pringle, HEK, Leather, SR & **Sage, RB** (2015) Foraging opportunities for farmland birds in and around *miscanthus* and Short-Rotation Coppice biomass crops. *Aspects of Applied Biology*, 131: 135-141.

Rantanen, EMI, Macdonald, DW, **Sotherton, NW & Buner, F** (2015) Improving reintroduction success of the grey partridge using behavioural studies. In: Macdonald, DW & Feber, RE (eds) *Wildlife Conservation on Farmland. Volume 1. Managing for Nature on Lowland Farms:* 241-254. Oxford University Press, Oxford.

Sage, RB, Wilson, S & Powell, A (2015) Using fledged brood counts of hedgerow birds to assess the effect of summer agri-environment scheme options. *Ecological Indicators*, 57: 376-383.

Sage, RB & Sotherton, NW (2015) Predation of woodland bird nests by tree squirrels in Britain, Central Europe and North America. In: Shuttleworth, CM, Lurtz, PW & Hayward, MW (eds) *Red Squirrels: Ecology, Conservation & Management in Europe:* 147-162. European Squirrel Initiative, Woodbridge.

Sánchez-García, C, Buner, FD & Aebischer, NJ (2015) Supplementary winter food for gamebirds through feeders: which species actually benefit? *Journal of Wildlife Management,* 79: 832-845.

Stoate, C, Leake, AR, Jarvis, PE, Szczur, J & Moreby, SJ (2015) The Allerton Project: twenty-three years of agricultural and environmental data collection on a commercial farm. *Aspects of Applied Biology,* 128: 27-33.

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Whiteside, MA (2015) *How early rearing conditions influence behaviour and survival of pheasants released into the wild.* Unpublished PhD thesis. University of Exeter, Exeter.

Whiteside, MA, Sage, RB & Madden, JR (2015) Diet complexity in early life affects survival in released pheasants by altering foraging efficiency, food choice, handling skills and gut morphology. *Journal of Animal Ecology,* 84: 1480-1489.

Wood, TJ, **Holland, JM** & Goulson, D (2015) Pollinator-friendly management does not increase the diversity of farmland bees and wasps. *Biological Conservation,* 187: 120-126.

Wood, TJ, **Holland, JM** & Goulson, D (2015) A comparison of techniques for assessing farmland bumblebee populations. *Oecologia*, 177: 1093-1102.

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Financial report

for 2015

KEY POINTS

- Overall funds decreased by £386,204, including a decrease of £204,518 on unrestricted funds.
- Income was £7.19 million, a decrease of 3.6% from 2014 (which had been a record year).
- Expenditure on research exceeded £4.1 million.
- The Trust's net assets were £8.35 million at the end of the year.

The summary report and financial statement for the year ended 31 December 2015, set out below and on pages 84 to 85, consist of information extracted from the full statutory Trustees' report and consolidated accounts of the Game & Wildlife Conservation Trust and its wholly-owned subsidiaries Game & Wildlife Conservation Trading Limited and GWCT Events Limited (formerly Game Conservancy Events Limited). They do not comprise the full statutory Trustees' report and accounts, which were approved by the Trustees on 14 April 2016 and which may be obtained from the Trust's Headquarters. The auditors have issued unqualified reports on the full annual accounts and on the consistency of the Trustees' report with those accounts, and their report on the full accounts contained no statement under sections 498(2) or 498(3) of the Companies Act 2006.

Although our fundraising was again very successful in 2015, the results for the year also reflect the fact that two large EU-funded projects came to an end, which resulted in an over decrease of £275,000 in the Trust's income. Expenditure increased by about £322,000, largely as a result of the new demonstration farm which the Trust has inaugurated in Scotland, and which was expected to have a deficit in its first year. The overall result was therefore a deficit of £386,204, of which £204,518 relates to the unrestricted funds.

The unrestricted investments and Underwood endowment produced total returns of 2.9% which is considerably better than their manager's investment policy which remains to exceed the return on cash. The ARET endowment achieved a total return of 3.1%, which is rather above its blended benchmark of 2.2%.

The Trustees continue to keep the Trust's financial performance under close review and to take appropriate measures to protect the Trust against the inevitable uncertainty in fundraising in the current climate. They continue to be satisfied that the Trust's overall financial position is sound. The Trust's reserves policy is that unrestricted cash and investments should exceed £1.5 million and must not fall below £1 million. At the end of 2015 the Trust's reserves (according to this definition) were around £1.1 million.

The Trust's five year business plan was prepared in March 2012. The key aims are:

1. To focus on three areas of work: species recovery, game and wildlife management and wildlife-friendly farming.
2. To strengthen our ability to deliver the results and implications of that science to our three audience groups: the public, policy makers and practitioners.
3. To maintain the financial security of the Trust.
4. To improve the profile of the Trust and to make us a more relevant organisation to a broader range of stakeholders.

These continue to direct our work; our research and policy initiatives aim to deliver effective wildlife conservation alongside economic land use and in the light of the new challenges of food security and climate change. Our focus on practical conservation in a working countryside makes our work even more relevant as these challenges unfold.

I Coghill
Chairman of the Trustees

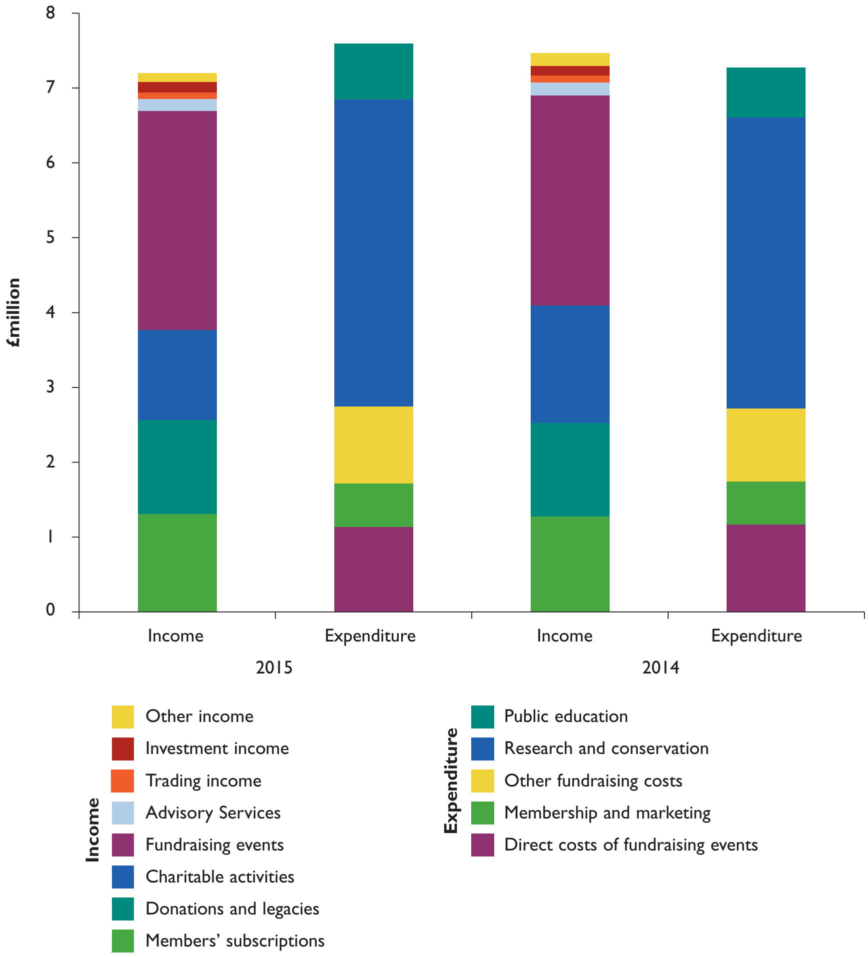

Figure 1

Total incoming and outgoing resources in 2015 (and 2014) showing the relative income and costs for different activities

Independent auditors' statement

to the Trustees and Members of the Game & Wildlife Conservation Trust (limited by guarantee)

We have examined the summary financial statement for the year ended 31 December 2015 which is set out on pages 84 and 85.

Respective responsibilities of Trustees and Auditors

The trustees are responsible for preparing the summarised Financial Report in accordance with applicable United Kingdom law. Our responsibility is to report to you our opinion of the consistency of the summary financial statement with the full annual financial statements and the Trustees' Report, and its compliance with the relevant requirements of section 427 of the Companies Act 2006 and the regulations made thereunder.

We also read the other information contained in the summarised Financial Report and consider the implications for our report if we become aware of any apparent misstatements or inconsistencies with the summary financial statement. The other information comprises only the Review of Financial Performance.

We conducted our work in accordance with Bulletin 2008/3 issued by the Auditing Practices Board. Our report on the Trust's full annual financial statements describes the basis of our opinion on those financial statements.

Opinion

In our opinion the summary financial statement is consistent with the full annual financial statements of the Game & Wildlife Conservation Trust for the year ended 31 December 2015 and complies with the applicable requirements of Section 427 of the Companies Act 2006 and the regulations made thereunder.

FLETCHER & PARTNERS
Chartered Accountants and Statutory Auditors
Salisbury, 29 April 2016

Consolidated

Statement of financial activities

	General Fund £	Designated Funds £	Restricted Funds £	Endowed Funds £	**Total 2015 £**	Total 2014 £
INCOME AND ENDOWMENTS FROM:						
Donations and legacies						
Members' subscriptions	1,297,683	-	12,875	-	**1,310,558**	1,278,160
Donations and legacies	657,481	-	597,494	-	**1,254,975**	1,245,246
	1,955,164	-	610,369	-	**2,565,533**	2,523,406
Charitable activities	221,842	-	985,283	-	**1,207,125**	1,573,883
Other trading activities						
Fundraising events	2,909,014	-	11,430	-	**2,920,444**	2,806,522
Advisory Service	161,591	-	-	-	**161,591**	172,436
Trading income	89,009	-	-	-	**89,009**	88,673
Investment income	11,368	-	110,739	14,899	**137,006**	134,120
Other	26,404	-	84,866	-	**111,270**	165,975
TOTAL	5,374,392	-	1,802,687	14,899	**7,191,978**	7,465,015
EXPENDITURE ON:						
Raising funds						
Direct costs of fundraising events	1,137,364	-	-	-	**1,137,364**	1,171,506
Membership and marketing	583,232	-	-	-	**583,232**	570,144
Other fundraising costs	1,019,882	-	-	8,366	**1,028,248**	977,848
	2,740,478	-	-	8,366	**2,748,844**	2,719,498
Charitable activities						
Research and conservation						
Lowlands	1,283,997	-	320,356	-	**1,604,353**	1,495,885
Uplands	423,505	-	239,170	-	**662,675**	636,833
Demonstration	258,758	-	1,174,915	4,150	**1,437,823**	1,145,834
Fisheries	262,802	-	136,470	-	**399,272**	609,926
	2,229,062	-	1,870,911	4,150	**4,104,123**	3,888,478
Public education	619,901	-	71,642	50,000	**741,543**	664,696
	2,848,963	-	1,942,553	54,150	**4,845,666**	4,553,174
TOTAL	5,589,441	-	1,942,553	62,516	**7,594,510**	7,272,672
Net gains/(losses) on investments:						
Realised	(223)	-	-	7,276	**7,053**	7,726
Unrealised	10,754	-	-	(1,479)	**9,275**	30,369
NET INCOME/(EXPENDITURE)	(204,518)	-	(139,866)	(41,820)	**(386,204)**	230,438
Transfers between funds	-	-	-	-	**-**	-
NET MOVEMENT IN FUNDS	(204,518)	-	(139,866)	(41,820)	**(386,204)**	230,438
RECONCILIATION OF FUNDS						
Total funds brought forward	2,271,270	136,492	510,877	5,826,140	**8,744,779**	8,514,341
TOTAL FUNDS CARRIED FORWARD	£2,066,752	£136,492	£371,011	£5,784,320	**£8,358,575**	£8,744,779

Consolidated

Balance sheet

as at 31 December 2015

	2015	2015	2014	2014
	£	£	£	£
FIXED ASSETS				
Tangible assets		3,318,239		3,196,907
Investments		3,894,952		4,193,852
		7,213,191		7,390,759
CURRENT ASSETS				
Stock	403,426		387,449	
Debtors	819,769		913,600	
Cash at bank and in hand	1,049,698		1,207,345	
	2,272,893		2,508,394	
CREDITORS:				
Amounts falling due within one year	567,490		655,603	
NET CURRENT ASSETS		1,705,403		1,852,791
TOTAL ASSETS LESS CURRENT LIABILITIES		8,918,594		9,243,550
CREDITORS:				
Amounts falling due after more than one year		560,019		498,771
NET ASSETS		£8,358,575		£8,744,779
Representing:				
CAPITAL FUNDS				
Endowment funds		5,784,320		5,826,140
INCOME FUNDS				
Restricted funds		371,011		510,877
Unrestricted funds:				
Designated funds	136,492		136,492	
Revaluation reserve	302,722		323,848	
General fund	1,720,351		1,904,053	
Non-charitable trading fund	43,679		43,369	
		2,203,244		2,407,762
TOTAL FUNDS		£8,358,575		£8,744,779

Approved by the Trustees on 14 April 2016 and signed on their behalf

I COGHILL
Chairman of the Trustees

Staff

of the Game & Wildlife Conservation Trust
in 2015

CHIEF EXECUTIVE	Teresa Dent BSc, FRAgS
Personal Assistant	Sue McKechnie *(until July);* Laura Gell *(from July)*
Head of Finance	James McDonald ACMA, CGMA *(until August)*
Chief Finance Officer	Nick Sheeran BSc, ACMA, CGMA *(from November)*
Finance Assistant - Limited	Lin Dance
Accounts Assistant	Suzanne Hall *(until June); Tessa Daniel (from March)*
Accounts Assistant (p/t)	Jill Reid *(from June)*
Accounts Assistant (p/t)	Helen Aebischer *(from March)*
Head of Administration & Personnel	Jayne Cheney Assoc CIPD
Administration & Personnel Assistant (p/t)	Lindsay Watson BSc, MSc *(until December)*
Head Groundsman (p/t)	Craig Morris
Headquarters Cleaner (p/t)	Rosemary Davis *(until November)*
Headquarters Janitor (p/t)	Chris Johnson *(until December)*
Head of Information Technology	James Long BSc
DIRECTOR OF RESEARCH	Nick Sotherton BSc, PhD, ARAgS
Personal Assistant (p/t)	Lynn Field
Head of Database	Corinne Duggins Lic ès Lettres
Project Administrator - MorFish, Quessa & Waders for Real	Paul Stephens BApp.Sc
Head of Fisheries	Dylan Roberts BSc
Head of Fisheries – Research	Rasmus Lauridsen BSc, MSc, PhD
Senior Fisheries Scientist	William Beaumont MIFM
MorFish Project Scientist/Fisheries Scientist *(from July)*	Stephen Gregory BSc, MPhil, PhD
Research Assistant	Luke Scott
PhD Student *(University of Exeter)* - Atlantic salmon genetics	Charles Ikediashi BSc
PhD Student *(University of Southampton)* - beavers and salmonids	Robert Needham BSc
PhD Student *(University of Queen Mary London) - Ranunculus*	Jessica Marsh BSc
PhD Student *(University of Queen Mary London)* - low flows on salmonids and river ecosystems	Jessica Picken BSc MSc
MSc Student *(University of Cardiff)* - salmon redd distribution	Elinor Parry BSc
Head of Lowland Gamebird Research	Rufus Sage BSc, MSc, PhD
Ecologist - Pheasants, Wildlife (p/t)	Maureen Woodburn BSc, MSc, PhD
Contract Ecologist	Aidan Hulatt BSc *(April)*
Bird Surveyor	Tony Powell *(May-June)*
PhD Student *(Imperial College, London)* - birds and miscanthus	Henrietta Pringle BSc
PhD Student *(University of Exeter)* - pheasant behaviour	Mark Whiteside MSc
PhD Student *(Harper Adams University)* - Syngamus in pheasants	Owen Gethings MSc
PhD Student *(Exeter University)* - corvids and songbirds	Lucy Capstick MSc
PhD Student *(Exeter University)* - pheasant release pens	Andy Hall MSc *(from September)*
MSc Student *(Imperial College London)*	Jenny Peach BSc
MSc Student *(University of York)*	Maria Christou BSc
Placement Student *(University of Leeds)*	Alice Deacon *(from September)*
Head of Wetland Research	Andrew Hoodless BSc, PhD
Research Ecologist	Kaat Brulez MSc, PhD
Research Ecologist	Carlos Sanchez Garcia Abad PhD, BVSc
Ecologist – LIFE Waders for Real	Lizzie Grayshon BSc
Research Assistant/PhD Student *(p/t University of Nottingham)* - woodcock	Chris Heward BSc
PhD Student *(University of Reading)* - game landscapes	Jessica Neumann BSc *(until May)*
MSc Student *(University of Reading)* - lapwings on fallow plots	Kelly Hedges BSc
MSc Student *(University of Leeds)* - lapwings on wet grassland	Victoria Boult BSc
MSc Student *(University of Leeds)* - predator responses by lapwings	Holly Alexander BSc
Placement Student *(University of Leeds)*	Joel Brittain *(until September)*
Placement Student *(University of Leeds)*	Leah Kelly *(until September)*
Placement Student *(University of Bath)*	Tom Oakley *(from November)*
Head of Predation Control Studies	Jonathan Reynolds BSc, PhD
Senior Field Ecologist	Mike Short HND
Research Ecologist	Tom Porteus BSc, MSc, PhD
Head of Farmland Ecology	John Holland BSc, MSc, PhD
Senior Ecologist	Barbara Smith BSc, PhD *(until May)*
Senior Entomologist	Steve Moreby BSc, MPhil
Research Scientist	Niamh McHugh BSc, MSc, PhD *(from September)*
Research Assistant	Matthew Brown BSc *(until December)*
Research Assistant	Tom Elliott *(from June)*
PhD Student *(Imperial College London)* - stewardship and farmland birds	Niamh McHugh BSc, MSc *(until June)*
PhD Student *(University of Sussex)* - stewardship on wild bees	Tom Wood BSc, MSc
MSc Student *(Leeds University)* - chick food and farming systems	Sarah Richardson BSc
MSc Student *(Imperial College, London)* - bumblebees and wildflowers	Katherine Taylor BSc
Placement Student *(University of Sheffield)*	David Stevenson *(until September)*
Placement Student *(University of Bath)*	Laura James *(until September)*
Placement Student *(University of Nottingham)*	Belinda Bown *(from September)*
Placement Student *(University of Bath)*	Jasmine Clark *(from September)*
Placement student *(Sparsholt College)*	Emily Turner *(June-September)*
Placement student *(Exeter University)*	Jessica Martin *(May-August)*
Director of Upland Research	David Baines BSc, PhD
Office Manager, Uplands	Julia Hopkins
Senior Scientist	Phil Warren BSc, PhD
Research Assistant	Michael Richardson BSc
Research Assistant	Gail Roberston BSc, MSc, PhD
Research Assistant	Helen Allinson *(January-November)*
Research Ecologist Langholm	Sonja Ludwig MSc, PhD
PhD student *(University of Newcastle)* - buzzards and grouse	Richard Francksen BSc, PhD
Placement Student *(University of Bath)*	Emily Trevail *(until August)*
Placement Student *(Liverpool John Moores)*	Hannah Greetham *(from August)*

Placement Student *(University of Cardiff)*	Harriett Fuller *(until August)*
Placement Student *(University of Bangor)*	Rhodri Evetts *(from August)*
Placement Student *(University of Bath)*	Nancy Parsons *(from August)*
Senior Scientist - North of England Grouse Research	David Newborn HND
Senior Scientist - Scottish Upland Research	Kathy Fletcher BSc, MSc, PhD
Research Assistant - Scottish Upland Research (p/t)	David Howarth
Research Assistant - Scottish Upland Research	Kayleigh Hogg *(March-June)*
Research Assistant - Wales	Merlin Becker MSc *(until August)*
Placement Student *(University of Birmingham)*	Amy Withers *(until September)*
Head of Advisory	Roger Draycott HND, MSc, PhD[2]
Co-ordinator Advisory Services (p/t)	Lynda Ferguson
Biodiversity Advisor – Farmland Ecology	Peter Thompson DipCM, MRPPA (Agric)
Head of Education	Mike Swan BSc, PhD[3]
Regional Advisor – central England	Austin Weldon BSc, MSc
Game Manager – Rotherfield Park	Malcolm Brockless

DIRECTOR OF POLICY & THE ALLERTON PROJECT	Alastair Leake BSc (Hons), MBPR (Agric), PhD, FRAgS, MIAgM, CEnv
Secretary (p/t)	Katy Machin, Sarah Large
Head of Research for the Allerton Project	Chris Stoate BA, PhD
Ecologist	John Szczur BSc
Senior Research Assistant	Nicola Hinton BSc, PhD *(until August)*
Soil Scientist	Felicity Crotty BSc, PhD *(from October)*
Game Manager	James Watchorn *(until May);* Matthew Coupe *(from May)*
PhD Student *(Harper Adams University)* - multifunctional field margins	Claire Blowers BSc MSc
PhD Student *(Leicester University)* - soil biology	Falah Hamad BSc MSc
PhD Student *(University of Nottingham)* - soil properties	Stephen Jones BSc MSc
Head of Education and Development	Jim Egan
Policy Officer UK	Sofi Lloyd
Farm Manager	Philip Jarvis MSc
Farm Assistant	Michael Berg
Farm Assistant	Ben Jarvis

DEPUTY DIRECTOR OF RESEARCH	Nicholas Aebischer Lic ès Sc Math, PhD
Secretary, Librarian & National Gamebag Census Co-ordinator	Gillian Gooderham
Senior Conservation Scientist	Francis Buner Dipl Biol, PhD
SSCS Cambridge intern (Wildlife Wing HP, India)	Devinder Singh Dhadwal *(April)*
Head of Geographical Information Systems	Julie Ewald BS, MS, PhD
Partridge Count Scheme Co-ordinator	Neville Kingdon BSc
Biometrics/GIS Assistant	Ryan Burrell BSc
Biometrics/GIS Assistant	Sebastian Aebischer *(June-October)*
Placement Student *(University of the West of England)*	Georgina Tucker *(until September)*
Placement Student *(University of Southampton)*	Sophie Watts *(until September)*
Placement Student *(University of Bangor)*	William Connock *(from September)*
Placement Student *(University of Bath)*	Philip Nassr *(from September)*
Placement Student *(University of Bath)*	Emma Popham *(from September)*

DIRECTOR OF FUNDRAISING	Edward Hay
London Events Manager	Lucinda Pearson *(until April)*; Pip Menzies *(from April)*
London Events Assistant	Tortie Hoare *(until September)*
London Events Assistant	Florence Kerr *(from January)*
London Events & Sponsorship Assistant	Isabel Stewart *(from October)*
Northern Regional Fundraiser (p/t)	Sophie Dingwall
Southern Regional Fundraiser	Max Kendry
Eastern Regional Fundraiser	Lizzie Herring
Regional Organiser (p/t)	Gay Wilmot-Smith BSc
Regional Organiser (p/t)	Charlotte Meeson BSc
Regional Organiser (p/t)	David Thurgood
Regional Organiser (p/t)	Sarah Matson
Regional Organiser (p/t)	Louise Jones *(from January)*
Fundraiser - Scotland	Andrew Dingwall-Fordyce
National Development Manager (p/t)	Jennifer Thomas
Administration Assistant	Daniel O'Mahony

DIRECTOR OF COMMUNICATIONS, MARKETING & MEMBERSHIP	Andrew Gilruth BSc
Head of Media	Morag Walker MIPR *(until July)*
PR Assistant (p/t)	Daniel O'Mahony *(until July)*
Communications Officer	Emma Graver *(from October)*
Publications Officer	Louise Shervington
Membership & Marketing Administrator (p/t)	Beverley Mansbridge
Shop Assistant (p/t)	Melani Cartwright *(September-December)*
Membership Assistant (p/t)	Angela Hodge *(until August);* Kathryn Kelleher *(from August)*
National Recruitment Manager	Andy Harvey
Digital Fundraising & Marketing Officer	Rob Beeson
Direct Mail Fundraising & Marketing Officer	James Swyer
Website Editor	Oliver Dean
Events Manager (p/t)	Adrienne Tollman

DIRECTOR SCOTLAND	Adam Smith BSc, MSc, DPhil
Scottish HQ Administrator (p/t)	Irene Johnston BA
Head of PR & Education - Scotland (p/t)	Katrina Candy HND *(until July)*
Policy Officer Scotland	Gemma Hopkinson MA
Senior Scottish Advisor & Scottish Game Fair Chairman	Hugo Straker NDA[1]
Head of Scottish Lowland Research	David Parish BSc, PhD
Research Assistant - GWSDF Auchnerran	Alison Espie
Research Assistant - Scottish Grey Partridge Recovery Project	Anna McWilliam
MSc Student *(University of York)* - habitat use by bats	Andy Clark
MSc Student *(Imperial College London)* - red squirrels and pine marten	Lydia Murphy
MSc Student *(Imperial College London)* - otters and water voles	Charlotte Ivison
Shepherd Manager GWSDF Auchnerran	Allan Wright *(from November)*

[1] Hugo Straker is also Regional Advisor for Scotland and Ireland; [2] Roger Draycott is also Regional Advisor for eastern and northern England, [3] Mike Swan is also Regional Advisor for the south of England and Wales

External committees with GWCT representation

1. Advanced NFP Integra User Group — James Long
2. BASC Gamekeeping and Gameshooting — Mike Swan
3. BBC Scottish Rural and Agricultural Advisory Committee — Adam Smith
4. Bird Expert Group of the England Biodiversity Strategy — Nicholas Aebischer
5. CFE Hampshire Co-ordinator — Peter Thompson
6. CFE National Industry Initiative Forum — Jim Egan
7. CFE National Delivery Group — Jim Egan
8. Capercaillie BAP Group — David Baines/Adam Smith/Kathy Fletcher
9. Capercaillie Research Group — David Baines
10. Code of Good Shooting Practice — Mike Swan
11. Cold Weather Wildfowl Suspensions — Mike Swan/ Adam Smith
12. Conservation Grade — Peter Thompson
13. Cornish Red Squirrel Project — Nick Sotherton
14. Council of the World Pheasant Association — Nick Sotherton
15. Countryside Stewardship Defra Informal Group — Jim Egan
16. Deer Initiative — Austin Weldon
17. Deer Management Qualifications — Austin Weldon
18. Defra Upland Stakeholder Forum and Upland Management sub-group — Adam Smith/ David Newborn/ Teresa Dent
19. Defra Hen Harrier Action Plan Group — Adam Smith/ Teresa Dent
20. English Black Grouse BAP Group — Phil Warren/ David Baines
21. Executive Board of Agricology — Alastair Leake
22. Farmland Biodiversity 'Toolkit' Partnership — Peter Thompson
23. Fellow of the National Centre for Statistical Excellence — Nicholas Aebischer
24. Freshwater Fisheries CEO Meetings — Nick Sotherton
25. Futurescapes Project: North Wales Moorlands — David Baines
26. FWAG (Administration) Ltd — Alastair Leake
27. Gamekeepers Welfare Trust — Mike Swan
28. Hampshire Ornithological Society — Peter Thompson
29. Hares Best Practice Group — Mike Swan
30. Heather Trust Board — Adam Smith
31. Honorary Scientific Advisory Panel of the S&TC — Nick Sotherton
32. IUCN/SSC European Sustainable Use Specialist Group — Nicholas Aebischer/ Julie Ewald
33. IUCN/SCCS Galliformes Specialist Group — Francis Buner
34. IUCN/SSC Grouse Specialist Group — David Baines
35. IUCN/SCCS Re-introduction Specialist Group — Francis Buner
36. IUCN SSC Woodcock & Snipe Specialist Group — Andrew Hoodless
37. Joint Hampshire Bird Group — Peter Thompson
38. Lead Ammunition Group – Primary Evidence and Risk Assessment Working Group — Alastair Leake
39. Leaf Marque Technical Advisory Committe — Jim Egan
40. Leckford Estate — Nick Sotherton
41. LEAF Policy and Communications Advisory Committee — Alastair Leake
42. Marlborough Downs NEP Board — Teresa Dent
43. Marlborough Downs NIA Species Delivery Group — Peter Thompson
44. Moorland Gamekeepers' Association — David Newborn
45. Natural England – Main Board — Teresa Dent
46. Natural England National Arable Systems Option — Peter Thompson
47. Natural England National CAP Species Workstream Review — Peter Thompson
48. NFU East Midlands Combinable Crops Board — Phil Jarvis
49. NFU County Chairman Leics, Northants, Rutland (LNR) — Phil Jarvis
50. NFU National Environment Forum — Phil Jarvis
51. NGO Committee — Mike Swan
52. Norfolk CFE Local Liaison Group — Roger Draycott
53. North Wales Moors Partnership — David Baines
54. North Wessex Farmland Bird Advisor Steering Committee — Peter Thompson
55. Perthshire Black Grouse Group — Kathy Fletcher
56. Operation Turtle Dove, Suffolk and Essex Steering Committee — Roger Draycott
57. Oriental Bird Club, Conservation Committee — Francis Buner
58. Pesticides Forum Indicators Group of the Chemicals Regulation Directorate — Julie Ewald
59. Purdey Awards — Mike Swan
60. RASE Awards Panel — Alastair Leake
61. Rivers and Lochs Institute Advisory Group — Adam Smith
62. Rothamsted Research — Alastair Leake
63. Rural Environment and Land Management Group — Gemma Hopkinson/ Adam Smith
64. Scientific Advisory Committee of the Office National de la Chasse et de la Faune Sauvage — Nicholas Aebischer
65. Scotland's Moorland Forum and sub-groups — Adam Smith/ Gemma Hopkinson
66. Scotland's Rural College Council — Adam Smith
67. Scottish Black Grouse BAP Group — Phil Warren/ David Baines
68. Scottish Game Industry Snare Training Group — Hugo Straker
69. Scottish Biodiversity Strategy Executive and two sub-groups — Andrew Salvesen/ Adam Smith/ Gemma Hopkinson
70. Scottish Government CAP Greening Stakeholder Group — Gemma Hopkinson
71. Scottish Parliament Rural Policy Cross Party Working Group — Gemma Hopkinson
72. Scottish Government CAP Reform Stakeholder Group — Gemma Hopkinson
73. Scottish Land & Estates Moorland Working Group — Adam Smith
74. Scottish Moorland Groups (four regional groups) — Adam Smith/ Hugo Straker
75. Scottish PAW Executive, Raptor and Science sub-groups — Adam Smith
76. SNH Deer Management Round Table — Gemma Hopkinson
77. SNH Moorland Sustainability Review — Adam Smith
78. SNH National Species Reintroduction Forum — Adam Smith
79. SNH Scientific Advisory Committee Expert Panel — Nicholas Aebischer
80. South Downs Farmland Bird Initiative — Julie Ewald
81. South West Farmland Bird Advisor Steering Committee — Peter Thompson
82. Stiperstones and Cordon Hill Curlew Recovery Project — Andrew Hoodless
83. Strathspey Black Grouse Group — Kathy Fletcher
84. Sustainable Intensification Research Platform — Chris Stoate
85. Technical Assessment Group (Scotland) — Hugo Straker/ Mike Short/ Jonathan Reynolds
86. The ACP Environmental Panel — Alastair Leake
87. The ACP/COT Bystanders Risk Assessment Working Group — Alastair Leake
88. The Agri-Environment Stakeholder Group — Jim Egan
89. The Bracken Control Group — Alastair Leake
90. The CAAV Agriculture and Environment Group — Jim Egan
91. The England Terrestrial Biodiversity Group — Jim Egan
92. The FWAG Association Steering Committee — Jim Egan
93. The TBG Funders Task & Finish Group — Jim Egan
94. The UK Pesticides Forum — Alastair Leake
95. Understanding Predation Project Steering Group — Adam Smith
96. Upland Hydrology Group — David Newborn
97. UK Avian Population Estimates Panel (JNCC-led) — Nicholas Aebischer
98. UK Birds of Conservation Concern Panel (RSPB-led) — Nicholas Aebischer
99. Voluntary Initiative National Steering Group — Jim Egan
100. Voluntary Initiative National Strategy Group — Jim Egan
101. Voluntary Initiative Water sub group — Chris Stoate
102. Welland Rivers Trust — Chris Stoate
103. Welland Valley Partnership — Chris Stoate
104. Welsh Bird Conservation Forum — David Baines
105. Wildlife Estates England Steering Group — Roger Draycott
106. Wildlife Estates Scotland Expert Panel — Adam Smith
107. Winning Ways for Wildlife (Hampshire group) — Peter Thompson
108. World Pheasant Association Scientific Advisory Committee — David Baines
109. Scottish Farmed Environment Forum — Gemma Hopkinson/ Adam Smith

Key to abbreviations: ACP = Advisory Committee on Pesticides; BAP = Biodiversity Action Plan; BASC = British Association for Shooting and Conservation; BCPC = British Crop Production Council; CAAV = Central Association of Agricultural Valuers; CAP = Common Agricultural Policy; CFE = Campaign for the Farmed Environment; COT = Committee on Toxicity; FWAG = Farming & Wildlife Advisory Groups; IUCN = International Union for Conservation of Nature, JNCC = Joint Nature Conservation Committee; LEAF = Linking Environment And Farming; MESME =Making Environmental Stewardship More Effective; NGO = National Gamekeepers' Organisation; NIA = National Improvement Area; PAW = Partnership for Action Against Wildlife Crime; RSPB = Royal Society for the Protection of Birds; S&TC= Salmon & Trout Conservation UK SSC = Species Survival Commission; SNH = Scottish Natural Heritage; TBG = Terrestrial Biodiversity Group